

RAILWAY ENGINEERING

AND MAINTENANCE OF WAY.

WITH WHICH IS INCORPORATED

ROADMASTER AND FOREMAN

BRIDGES--BUILDINGS--CONTRACTING--SIGNALING--TRACK

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The Practical in Signal Design

WE frequently hear the practical man complain that designing engineers overlook many practical features. This is especially true of a new field or new type of work. When a scheme or undertaking is new, it is frequently impossible for the designer to get accurate knowledge of the requirements which are necessary to make construction, operation and maintenance economical and easiest of accomplishment by the field forces.

When designs are made for entirely new types of apparatus and installations, the designers are therefore likely to work entirely in accord with theoretical calculations or considerations, at the expense of the practical considerations; because of their lack of practical knowledge, and because what technical information they have is incomplete and they have to originate a great deal (thus limiting their time and tending to detract attention from the other features).

Among the branches of railway engineering, signalling is one of the newest, and its development has been phenomenally rapid. The knowledge of practical requirements has grown up simultaneously with the rapid developments in design. But naturally, since little practical knowledge was at first available, early designs were open to many criticisms from the field men.

Recent tendencies would seem to indicate that the development in designs, and the gradual adoption of standards (which decreases office work) has finally brought the art of signalling to a point where the practical requirements are receiving increasing attention.

This tendency was clearly illustrated in the design of the Joliet interlocking, an account of which was given on pages 227 to 233, May issue of RAILWAY ENGINEERING.

One feature in the interlocking machine tower is sufficient to illustrate the point—the depressed pit under the interlocking machine. With a 224-lever machine, only a practical man can appreciate the large number of conduits and wires which must be handled and connected up with the interlocker. In towers formerly built, all of these operations had to be made by the men lying or stooping down under the machine. Adjustments and repairs were difficult, required more time, and thus introduced the possibility of keeping the plant out of commission for a longer time, due to the unhandy working conditions.

Makers of delicate and precise measuring instruments have long realized that the comfort of the operator is vital in producing accurate results, and in the design of such instruments the human equation has been carefully considered. By building the depressed pit in the Joliet tower, the Rock Island signal officials were not only sure of greater rapidity in the original construction, but they are assured of greater rapidity in repairs, with lesser delays; and of even greater importance is the fact that, on account of the comparative comfort of the man, the work will be done more carefully and more thoroughly, thus tending toward repairs and adjustments that will be permanent, rather than temporary.

Deferred Work

THE deferring of necessary construction and maintenance of way betterments has continued for so many years that it has almost come to be a custom. If a property is in first-class shape such a policy can continue for a year or possibly two or three years without showing results which are noted by the general public. A year of slighted maintenance on a railway which is in poor condition, however, makes a decided difference in the condition of the roadbed.

High class railways have been able to keep their roadbeds in fairly good condition for the last few years while holding maintenance at the lowest figure, but this condition cannot continue indefinitely without resulting finally in decrease in efficiency.

New construction has received so many setbacks in recent years that it is extremely doubtful if railways could take care of the traffic in a normally prosperous year. Public opinion and adverse legislation has been greatly responsible for the situation, and condemnation will emanate from the same sources when railway facilities fall woefully short of the requirements.

Railway officials, however low their allowances have been cut, will have to shoulder the responsibility when the increase sets in. It therefore behooves each railway to have the entire matter in hand—to know just where the resources of the railway have been most greatly depleted—to know just where a dollar invested in additional facilities will return the quickest and largest dividends in getting traffic over the road. And not only should this information be fully digested by those officials who are responsible, but definite plans should be prepared, as far as possible with depleted forces, so that every move may count for the most when work opens up.

The co-operation of a number of broad-minded officials having intimate knowledge of the requirements of different departments will then be even more vitally necessary, in order that the development can be co-ordinated and the greatest immediate advantage taken of expenditures.

The lack of this co-operative planning has been costly in occasional instances in the past, for instance, where isolated stretches of second track have been put in or yards constructed without the fullest knowledge of future traffic requirements or contemplated changes.

If plans are completed for grade revision, and it is of pressing importance that this work be done at the earliest opportunity, the mechanical department should have fullest information on the subject. And if it is definitely settled that this grade revision is to be done with the first available capital, the motive power department may pass over the problem to the engineering department entirely, and let their plans and requirements deal with other portions of the line where improvement of physical conditions is not contemplated.

A comprehensive schedule or program, showing necessary improvements in the order of their importance, will be invaluable, especially if accompanied by estimated costs. Then, if a change of conditions comes and capital becomes available, each department head will have information as to the approximate amount of money available, and just about how far down the program it will carry him.

When there are a thousand jobs which ought to be done, it sometimes, or generally requires careful discrimination to determine just which item is the most important. And further, things that *must* be done should be carefully segregated for those that *ought* to be done, and the latter postponed until the actual necessities are provided for.

The Boston & Maine has issued plans and specifications for a bridge to be constructed over the Hudson River at Saratoga Junction, N. Y., calling for nine double-track spans requiring about 2,500 tons of structural steel. Bids are asked for the latter part of this month.

Failures in the exploitation of New Devices

THERE ARE, roughly speaking, two kinds of failures in the exploitation of new inventions covering alleged improvements in railway construction, maintenance and operation. We presume that this statement covers the industrial field generally, but are concerned only with such matters as they pertain to the railways.

We are all familiar with the type of poor inventor who is certain he has a wonderful patent and who, through ignorance of conditions or of business methods generally, is never able to make more than a faint start at its exploitation and ultimate adoption. He is foredoomed to failure, unless he is picked up by moneyed interests, whether his invention has merit or not. He is always with us and he always interests us. He is never dangerous or seriously objectionable. His failure harms no one but himself and he is usually quick to recover.

The second class of failure is not such a harmless one. It is the result of dishonest exploitation of meritless patents. A promoter does not need a really good patent or patented article of merit to serve his purpose if he is dishonest. The promotion of a stock company is sufficient to serve his ends and in the organization of such a stock company, his first move is to select a state with tax corporation laws. The device to be exploited is of secondary importance. This device must, however, be one which offers opportunity for sensational description; one, the universal use of which, may be described as a means of saving thousands of lives annually. The sale of one or more hundred thousand dollars in stock is the aim.

The canny promoter does not go to the officers of railway engineering departments to sell stock in a track device, nor does he go to officers of the mechanical department to promote a mechanical improvement. He would be handicapped in such cases by the technical knowledge of his victims. The stock sales are made among those who have seen just enough of railway work to appreciate that there is room for improvement, but who have no powers of analysis which go with technical knowledge and long experience. A stock argument is the supposed interest of politicians and the prospect that the Interstate Commerce Commission will order the device universally applied, in the interests of safety.

These methods hinder rather than forward real progress in the manufacture of transportation. Suspicion of anything new is fostered by experience with dishonest promotion. Were it possible to impress upon all with money to spend, that the advice and co-operation of the engineering staffs of the railways, is not impossible or difficult to secure for any legitimate and practical improvement in track construction, inventors would look for such evidence before spending money, with sly winks and insinuations, however, the promoters explain the lack of such evidence in the desire of the railway officers to spend no money for improvements, no matter how obvious or how needed, until forced to do so.

State of federal laws will, in time, correct the more glaring aspects of this evil, but its complete elimination by law cannot be expected. For the good of the cause engineering officers should not avoid opportunity to express themselves verbally and in public print in denouncing false devices, and encouragement should be unhesitatingly given where deserved.

The Patent Laws of Our Country

INDIVIDUAL inventors, whose brains have in the past given birth to the inventions and improvements which have been of greatest benefit in American industrial progress, are not being accorded a square deal by the present patent laws of the United States. There is a growing sentiment among those who have been brought to a realization of this fact, that there should be a comprehensive revision. Large manufacturers are in a position to protect themselves under present laws, and the unscrupulous among them find it a reasonably safe practice to infringe upon the patent rights of individuals in addition to the benefit derived through their own, which their power and not that of the Government renders safe from infringement.

Continued progress is dependent upon new inventions as it has been in the past. If the incentive to such invention by independent individuals is withdrawn by the lack of the protection which the present laws are supposed to give but which they do not give, inventive improvement will be retarded. By placing the burden of proof upon the inventor in case of infringement, the cost of obtaining proper protection is frequently prohibitive unless the case is prosecuted by persons with large financial resources, and the more important the invention the more difficult is its protection against infringement. Orville Wright is quoted as saying that it cost over two hundred thousand dollars to protect him in his important invention, although he was subsequently proved justified in the fight. It does not take an astute mind to realize the helplessness of the poor inventor in such a case.

A bill designed to remedy this condition has been introduced in Congress by Chairman Oldfield of the Patent Committee. The bill provides for a royalty to be paid the patentee after he has simply proved that his claims have been infringed, pending legal decision as to whether the claims were properly granted. This will give the inventor funds to prosecute his case and will, if passed, serve to alleviate conditions to some extent. It is not drastic enough in that it still saddles the inventor with the cost of proving the patent office correct in granting his claims, but it should be passed unless a stronger substitute can be put through.

As we go to press, the indications are that the railways are at last to be granted a just remuneration for the transportation of the mails. An increase amounting to over ten million dollars and a new method of computing by volume instead of weight is recommended by the congressional committee on mail pay. It also is authoritatively rumored that the freight rate increase case will have become history by the end of the month. If a horizontal increase of three to four per cent, or the equivalent, is allowed there will be a sudden dispelling of murky clouds.

PURIFICATION OF WATER FOR LOCOMOTIVES.

Editor *Railway Engineering*:

I have read with much interest the article on "Purification of Water for Locomotives" by Mr. La Bach, appearing in *Railway Engineering* for May. The writer has succeeded in giving a very clear and concise account of the entire subject.

The summary of the properties of various inorganic impurities found in water is especially good, while the table of the reactions of water treatment will be found of great convenience to students of the subject.

The treatment of the subject of corrosion will do much to clear up this confusing phase of the use of water in boilers.

The treatment of priming and foaming is a little disappointing.

The quotation defining these two terms is taken from a well known text on Water Treatment, but is not sufficiently clear to exert much influence in overcoming the popular habit of using these two terms as absolute synonyms. Had space permitted, a more complete discussion would seem desirable on the use of treated water in boilers, covering briefly the same ground treated so thoroughly by Mr. Pownall before the Western Railway Club some years ago.

It is to be noted that the writer agrees with the recent report of the Water Service Committee of the American Railway Engineering Association, that it is at present impossible to determine the economy of water treatment with any degree of accuracy. It is to be hoped that the missing data may some day be made available, for the accurate statement of the economy of water softeners will result in extensive developments in this line.

W. S. LACHER,

Office Engineer, C., M. & St. P. Ry.

Twenty Years Ago This Month

The Lehigh Valley has changed the length of its standard rail from 30 ft. to 45 ft.

An ordinance designed to compel the Lake Shore and the Rock Island to elevate their tracks in Chicago before August 1, 1899, was passed by the Chicago city council.

John McKinnon, president of the Indiana Steel Castings Co., has signed a contract to locate the plant of that company at Anderson, Ind., the original plant at Frankton having been destroyed by a cyclone.

H. U. Mudge has been appointed general superintendent of the eastern grand division of the Atchison, Topeka & Santa Fe.

The last stone of the great union station at St. Louis was placed June 18, it being the cap stone of the tower, weighing 7,500 pounds.

The Union Switch & Signal Co. has completed an interlocking plant at the Laughlin Y of the Pittsburgh Junction R. R. at Pittsburgh.

The New York & New Jersey bridge bill was passed by Congress and signed by the President June 5. The bridge is to span the North river between New York and New Jersey and is estimated to cost \$40,000,000. It is to be a suspended cantilever bridge, 150 feet above high water and is to be equipped with six tracks.

The Norfolk & Western has placed a large order for 60 ft. rails at a somewhat greater cost per ton than that of 30 ft. rails.

The rain making expedition sent into Nebraska by the Rock Island is said to have been successful in causing a hail storm, which resulted in considerable damage to property and on account of which the company is threatened with suits.

Floods in the Northwest were so serious that traffic on the Canadian Pacific, Great Northern and Northern Pacific has been held up for two weeks.

The Baltimore & Ohio ran a special train from Baltimore to Chicago, June 23, in 19 hours and 46 minutes.

The Boston & Albany has discharged its gangs of masons, carpenters and painters. It is the purpose to contract the work which was formerly done by these men.

J. B. Mitchell, superintendent of bridges and buildings, this month succeeded in saving one of two locomotives of the Cleveland, Cincinnati, Chicago & St. Louis which were dropped into the Wabash river at Terre Haute, Ind., by the failure of a bridge span following a collision in November, 1892. Nearly two years having elapsed, one of the engines was too deeply embedded in quick sand to make recovery possible. The other was lifted out by ingenious tactics adopted by Mr. Mitchell.

The electrocution of grass and weeds on the right of way of the Illinois Central is being experimented with. J. F. Wallace, chief engineer, has equipped a flat car with generating machinery, and current is conveyed to the weeds through a copper brush at 10,000 volts. The outfit moves about five miles per hour.

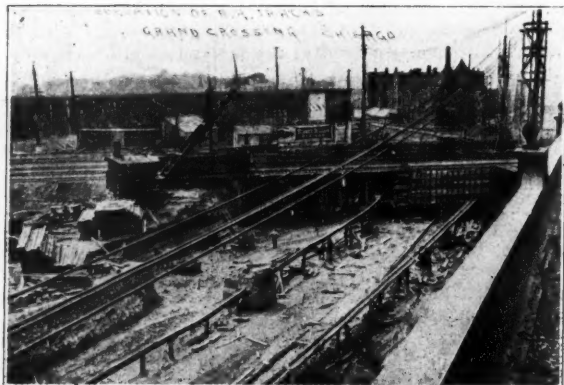
SURVEYS PRIOR TO TRACK ELEVATION.

By G. M. O'Rourke, Resident Engineer I. C. R. E.*

After the company accepts a track elevation ordinance the preliminary surveys necessary for the securing of data must be made to enable the engineers to intelligently design the subways, retaining walls and other structures.

The Chain Survey.

In beginning the chain survey the start should be made at some well defined point beyond one end of the proposed work. The stationing should be painted on the rail or on the stakes where a base line is necessary. Plusses are taken to all switch points, frogs, bridges, culverts or signs, fence lines, street or building lines and buildings on or adjacent to company way lands. Types and numbers of frogs and length of leads are noted. Type of switchstand or, if interlocked, the method of interlocking is made note of. The condition, height and type of all fences are recorded as well as the angle at which they intersect the right-of-way. The number of stories in all buildings is jotted down, also the nature of the building material, whether frame, brick, stone, concrete or frame covered with corrugated iron. The bridges must be classified, as truss, plate girder or concrete. If truss or girder bridge ob-



A Typical Street Crossing During Track Elevation.

serve whether it is a through or deck bridge, pin-connected or riveted and the length over-all and center to center of end pins. The design may also prove useful to the engineer working up the proposed change and some remarks should be made regarding same. The type and composition of piers or abutments, the area of opening and high-water mark in all culverts and arches, their length, material and type of construction, whether cast iron or concrete pipe, cut stone masonry or concrete culverts—in fact, every detail which may be of use to the designing engineer should be made note of in clear, legible lettering in a clean notebook.

The location, with reference to the railroad, of all poles should be noted and the use of pole recorded, that is, whether telegraph, electric light, telephone or trolley. Height of wires above top of rail is measured and the number of wires carried by the pole counted. The purpose of this is to facilitate the estimating work in the office. A glance at the plat should show exactly the number, type and condition of every structure affected by track elevation, the number of wires, ownership and location of poles which might have to be raised or entirely removed to permit the driving of falsework.

All underground construction must be carefully located and shown on the plat. The location and size of sewers, water and gas mains, electric light, telegraph and telephone conduits, etc., should be secured from public records and from the different corporations controlling these facilities. This information is verified as far as practicable in the field by locating manholes,

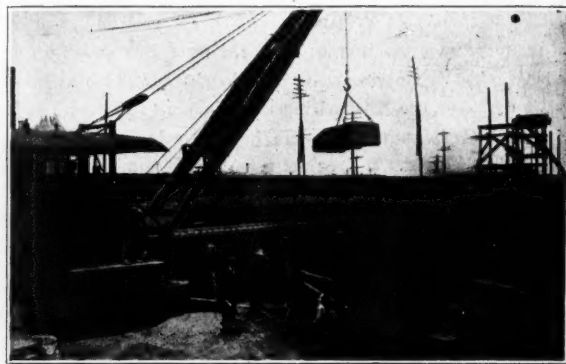
water hydrants, meters, etc., and during the level survey the elevation of flow lines of sewers.

Level Work.

The chain survey completed, the level work is begun. This consists of a base of rail and natural ground profile, and cross-sections of the railroad way lands and far enough beyond to reach any probable future toe of slope. These cross-sections are taken every 100 ft. and closer where the contour of the natural ground changes or where some obstruction is met between the stations which would change the quantities required for the fill. Profiles and cross-sections are platted up on transparent paper and blue-line prints are made, upon which the future grade line and cross-sections are platted and required quantities computed.

The elevations of loading platforms and basement floors of buildings immediately adjacent to right-of-way are taken. The thickness of basement floors and composition is reported. This information is required when designing retaining walls on the property line, that there may be no uncertainty as to the depth to carry foundations of wall.

All level work is referred to city datum. Some nearby city bench mark, the description and elevation of which is secured from public records, is used. The elevations of the flow lines



Handling Dirt in Skip With a Derrick.

of all sewers is referred to this bench also, and the description and elevation shown on the map for the benefit of those doing future field work.

Center Lines of Proposed Subways.

A plat in detail of each street where a subway is to be built is necessary to enable the railroad company to restore conditions as they were before track elevation. Type and condition of pavement, kind, condition and width of sidewalks, location of street railway tracks, if any, with reference to curbs, width of roadway and total width of street is noted and verified by comparison with recorded plats. Type, size and number of stories in every building on both sides of the street is required for a distance each way from the railroad great enough to be beyond any territory liable to be affected by construction work.

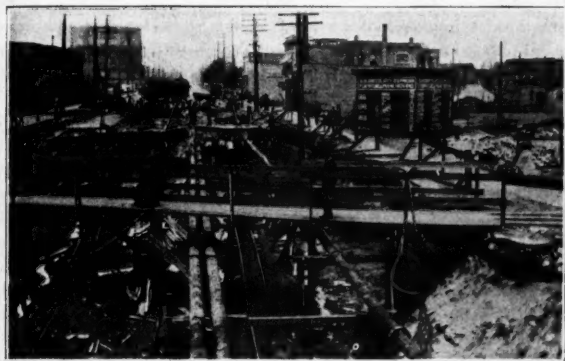
The location of sewers, manholes, catchbasins, inlets, etc., on nearby streets which were not secured during the general chain survey of company way lands should be obtained and the information shown on the map with the elevations of the flow lines of sewers at different points, and direction of flow. This is to facilitate the designing of that most important part of the subway, the method of removing water. Every street is cross-sectioned to ascertain the amount of excavation necessary. These sections on streets are usually taken (25) twenty-five feet apart for a distance of three hundred feet or more, depending upon the ordinance grade of future approach to subway.

Next comes the really difficult part of the survey, i. e., running out the street lines. The ordinance usually reads that at

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Blank street there is to be constructed a subway 66 ft. wide, 33 ft. each side of the center of the street. The center line of the street must be found. Usually the operations are confined to one section or to a mile of the street from one section line on one side of way lands to the line on opposite side. This is because so many section lines jog or offset, especially at the range lines. A start is made by comparing the center line between tracks of street railways with the center line between curbs and the center line between buildings. If they all agree the task is simple, but this is seldom the case. In recent years the street railways of many cities have had to rehabilitate and widen their track centers to accommodate larger rolling stock. Instead of throwing each track an equal distance away from the center line they throw one track just enough to make the required distance. This has been the case with the lines in Chicago which eliminates this heretofore fairly reliable center-line tie. The center between curbs and between buildings is very likely to coincide within a reasonable distance, but that is not close enough.

A substantial brick or stone front building is selected and the owner or lessee of same looked up. Very often he will have a plat of the original survey made just before his building was erected and from which can be secured the relative locations of the building and street line. Or there may be an old surveyor,



Showing Tracks, Pipe Lines and Overhead Wires, Encountered in Track Elevation Work.

in the locality who can tell quickly all the line points on the various streets. Marks left by surveyors in the past, a cluster of tacks in a board sidewalk or a stake, pipe, scratch on concrete walk or X cut in the top of a water hydrant may be the very point needed to establish the line. Occasionally a corner stone is found or a railhead, but not often, in the built-up portions of cities. After the line has been decided upon and the slight errors distributed evenly each side of the line, it is projected to the railroad and the angle of intersection read and recorded, and plus to center line of street found. Often where two railroads adjoin closely, or where very high-priced property is at stake, this work is assigned to some public surveyor of recognized standing, whose work is checked by the railroad engineering corps and permanent points set and referenced in to prominent points, as church steeples, large chimneys, etc.

The party required for a survey of this kind is usually composed of three men. The engineer in charge keeps notes and does the instrument work, and it is also customary to have him plot up the notes in the office for permanent record. The working drawing is made on a scale of 1"=50'. This scale permits the showing of any small obstruction or detail. Another plot on a scale of 1"=100' is made and submitted to the city for record. On this plot must be shown the proposed arrangement, also property lines, street lines, contour of natural ground, elevations of railroad and streets and construction above and below ground.

Foundations.

We now turn to the geological formations. After the design of the proposed subway has been decided upon it becomes necessary to know the depth to which the foundations must be carried to find a good bearing strata. This data is secured by test borings made on the site of the proposed subway or in the immediate vicinity. The elevation of the natural ground at the test hole is recorded, and when the boring is completed the foreman submits samples of each strata passed through, the depth from the surface to the top of each strata and thickness of each strata. The boring is carried about 10 ft. into solid rock to be certain that a ledge or boulder has not been struck.

In making these test borings an ordinary earth auger is used in passing through loam, clay and other earth which will stand up. When sand or gravel is reached, the hole bored is reamed out if not already large enough, and a pipe casing is inserted and driven into the sand. In passing through the sand a sand pump is used. This consists of a hollow iron cylinder with a valve at its foot opening upward. The sand pump is lowered to the bottom of the hole, covered with water and churned quickly up and down until the sand fills the pump, which is then withdrawn and emptied. When hardpan is reached a drill is used to break up the hard substance and on striking solid rock it often becomes necessary to substitute a diamond drill. The drillings are removed with the sand pump or a water jet. In removing the debris with the water jet, a pump will be required to force the water down through a small pipe which is inserted into the larger one, the borings being carried up through the larger one to the surface. Care must be exercised to get a good sample, as the water washes the clay away and does not always leave a good sample.

A tower 50 ft. or more in height, at the top of which is fastened a sheave to provide a means of raising the drills, sand pump, etc., from the holes, must be constructed. Near the base an arrangement is provided to raise and lower the drills and sand pump, with a rapid movement in the drilling process. A steam engine and belt and a hoisting engine are required to provide power. Three men can handle this work economically.

All this test boring data is placed on the working drawing in tabulated form in a conspicuous place near the zone of construction.

Where the design provides for but a few pedestal foundations, they are carried to solid rock. If the columns are numerous and the distance between them not great, a bearing on hardpan is usually found sufficient. Spread foundations and abutments are carried to a good bearing strata of gravel, sand or clay. If the strata lies too deep piles are resorted to.

DON'TS.

Don't nag. Many a good man has been nagged into inefficiency. Don't humiliate a man by advertising his shortcomings from the houstops, but quietly point them out to him.

Don't forget that a man who is made out of the right kind of stuff will resent a brutal call-down.

Don't be afraid to compliment commendable service. Other men are made of precisely the same kind of stuff you are.

Don't forget that what might have been done 25 years ago may be impracticable or unwise now.

Don't forget that while some men are criticising everybody else, it might be a good thing for the company were they to carefully look themselves over.

Don't forget that to criticise, without suggesting a remedy or better method, is a waste of time.

—H. W. Forman in Illinois Central Magazine.

The Illinois utilities commission has ordered the Chicago, Rock Island & Pacific to construct a passageway under its tracks in Morris, Ill. This road will also build a steel bridge across the South Canadian River at Bridgeport, Okla., to replace the structure lately damaged by flood.

WATERPROOFING SOLID FLOOR BRIDGES.

By J. B. W. Gardiner.

The primary object of this article is to raise in the minds of engineers who are interested in structures from a standpoint of efficiency, and therefore of maintenance, one question, viz.: With all of our facility for examination and tests, our knowledge of railroad needs and requirements, our experience with waterproofing materials, is it not possible to evolve a standard waterproofing specification which, to some extent, at least approaches the ideal and which is at the same time reasonable?

The secondary object is to present the arguments for and against the different kinds of waterproofing materials, and, by drawing from each that which is best, to formulate what might be termed a composite specification which will most nearly fulfill the requirements for bridge deck work.

This necessarily involves a discussion of the two parts of a waterproofing system, the membrane and the plying cement, and also, to a certain extent, of the processes of manufacture.

Asphalt and Coal Tar.

At the outset it might be stated that the best practice does not permit laying an asphalt treated membrane with coal tar, or vice versa. There is always a possibility, when two chemically dissimilar materials are kept in close contact, of setting up some chemical or electrical action. It will therefore be assumed that when an asphalt membrane is used, it should be laid in asphalt (and for the same reason, in the same asphalt which was used in treating it) and similarly, a coal tar membrane should be laid in coal tar.

The use of coal tar has been pretty generally discontinued in the East. As a matter of fact, there is only one Eastern road of importance which still uses it. All others use asphalt or some asphalt product. It is useless to point to the success of coal tar in other fields of waterproofing; equally so to refer to its proven long life. The coal tar of today is not the coal tar of twenty years ago. The dyes and other products which coal tar gives up under proper treatment are so vastly more valuable than the pure coal tar itself, that it is not commercially economical to sell it in its pure state. The result is that the coal tar on the market today has been deprived of most of its best qualities.

In addition, certain well known physical properties of coal tar make it an absolutely inadequate material for bridge deck work. It is extremely brittle even at comparatively high temperatures, from 40 to 45 deg. Fah., and cannot therefore stand without fracture, either the vibration caused by moving loads, or the slight movement in the concrete due to expansion and contraction. The first requisites demanded by the class of work under consideration are flexibility and ductility through a wide range of temperatures—say from 10 or 15 to 125 deg. Fah. Coal tar, moreover, forms but a weak bond with concrete or any other solid material.

The selection of an asphalt product presents great difficulty. There is a very wide range of asphalts, all of which are chemically similar though physically far apart. The first requisite, however, should be chemical purity, freedom from organic matter, loam or any soluble material. This excludes the Trinidad Lake asphalt,* which contains only 56 per cent bitumen and 44 per cent organic matter or other impurities. Asphalt to be a permanent waterproofing agent should be at least 98 per cent pure hydrocarbon. Again, it should be a naturally occurring asphalt and not a compound with Gilsonite. No Gilsonite product will bond to concrete and all such products lack flexibility and ductility. Moreover, being compounds, they are more apt to disintegrate than natural products which have been acted upon for centuries by

the same forces to which they are to be subjected in waterproofing work.

As to the proper melting point, there is wide divergence of opinion. An asphalt with a low melting point will, as a general rule, be more flexible and more ductile at low temperatures. For this reason it would seem to be advisable to use a material with a melting point as low as is consistent with proper application. There is, however, another consideration. The low melting point asphalts are not stable, but are comparatively short lived. The fact that the melting point is low, means that there is in the material a highly volatile hydrocarbon oil which is a solvent for the solid bitumen. It is this oil which keeps the melting point down. In fact, if it were present in sufficient quantity, the asphalt would be liquid. Exposed to the elements and extremes of temperatures, this oil volatilizes and the efficiency of the asphalt is impaired before it is even in place. The most recent investigations and tests indicate that while it is desirable to use an asphalt with a melting point as low as is consistent with permanency and stability, still there is a point somewhere between 125 and 150 deg. Fah. below which it is not safe to go.

For these reasons most engineers of today want an asphalt which melts between 175 to 200 deg. Fah., and which will at the same time be as ductile at low temperatures as the low melting point asphalts. These two requirements seem self-contradictory, but I can see no basic reason why reconciliation between them is not possible. The juice of the sugar cane can be converted into a heavy thick liquid—molasses; into a lumpy deliquescent powder—sugar; into a brittle or a tough solid—taffy, solely by heat properly regulated as to the time and degree. It is possible that heat regulation may do the same for asphalts.

It would seem, therefore, that the specification for an asphalt for waterproofing should be as follows:

"Asphalt shall be a tough, naturally occurring bitumen, showing at least 98 per cent pure hydrocarbon, having a melting point between 175 and 200 deg. Fah. It shall be flexible and ductile between 15 and 130 deg. Fah., and shall not run on a vertical surface in the heat of the summer sun. It shall form a tenacious mechanical bond not only to the membrane and the concrete to which it is applied, but also to the concrete which is cast against it. The asphalt shall be chemically inert, and impervious to and unaffected by either water, the alkalies in cement or the acids from cinders."

Membranes.

The membranes in more or less general use are so entirely different chemically and physically that any analysis tending to elicit an ideal composite specification must first involve some study of the methods of manufacture. For this purpose we can classify the membranes as follows:

1. Felts, including paper and wool felts.
2. Fabrics, including burlap and cotton fabrics.

Felts: Wool felt, by itself, is not impervious to water, and if continuously exposed to the action of water rapidly disintegrates. This applies equally well to all the membranes in use with the limitation that fabrics disintegrate only through rotting of the fibre, and not through a separation of constituent particles, as do felts. It, therefore, becomes necessary to treat these membranes in some way which will make them unaffected by water. In every case, all of these membranes are, or are claimed by their respective manufacturers to be, saturated with a preservative, either coal tar or bitumen. In the case of felts and papers it is a physical impossibility to accomplish such saturation. In proof of this it is only necessary to see a cross-section of them. Invariably this cross-section will be a light brown while the surface of the felt is black—showing that while there is bitumen on the outside there is none in the interior, as the bitumens are all black. The reasons for this are simple. Felts are exceedingly dense, and in order to saturate them with any material it must be as limpid as water. To reduce either a bitumen or a coal tar to this condition requires great heat, so much heat in fact that when the raw felt is immersed in the hot material it soon becomes coked or charred. Its value is thus completely destroyed. The

*The analysis of refined Trinidad Lake asphalt, as reported by Mr. Clifford Richardson in proceedings of American Society for Testing Materials, 1906, pp. 509, et seq., is as follows:

Bitumen	59.5%
Mineral matter	38.5%
Undermined organic matter	7%

The mineral matter, Mr. Richardson states, is found by elutriation to consist to a large extent of clay. There is therefore only 56½ per cent of the real waterproofing agent in asphalt of this type.

method in general use for accomplishing the saturation is to reduce the coal tar or bitumen to the necessary limpid state by means of a solvent and then to force the solution into the material. The solvents used are of the petroleum family and are usually petroleum residue or still bottom, and because of the necessity of having such a very limpid solution, it naturally contains a small percentage of bitumen and a large percentage of the solvent. The result is that the interior of the membrane is saturated principally with a petroleum residue, somewhat discolored by bitumen.

While this method of saturating the membrane in its manufacture may be effective in prolonging its life, it is totally wrong in principle, since the result will be that there is incorporated in the very heart of the waterproofing course a complete solvent for the mastic used. The writer has seen taken from one of our great public works, a square of five-ply felt laid with asphalt. The bottom layer was in perfect condition, as was the top; cross sections near the edge of the square were perfect. A cross section through the center of the square, however, showed a portion of the interior completely gone, the felt being a shreddy pulp, and the asphalt totally gone, indicating that locked up in this interior there must have been a solvent for the waterproofing.

With regard to burlap, there has never been produced such a thing as a burlap saturated with either bitumen or coal tar. It has been coated—nothing more. A cross section of any strand will show the core to be unchanged in color. Moreover, the jute oil in burlap leaves it in a short while, after which its life, strength and flexibility naturally are seriously impaired. The difficulty of saturating a burlap is, as in the case of felts, due to the nature of the material itself. When burlap is placed in hot melted bitumen, the jute oil is driven out as a vapor with greatly increased volume. This vapor, constantly expanding by the heat, forms a steam cushion around the burlap through which the bitumen cannot penetrate, causes the bitumen to overflow and finally forces it out of the container. Moreover, jute oil is itself a solvent for bitumens and, unless the jute oil is driven out, a reaction will occur between the bitumen and the oil in the burlap. Thus we move in a circle. To leave the oil in starts a reaction which must destroy the material. To take it out and fill its place with bitumen is an impossibility; and even were it not impossible, the removal of this essential oil takes away that on which the efficiency of the material depends.

Another point in the use of felts is that they are neither elastic nor flexible, and both these characteristics are essential in efficient waterproofing. In order to obtain good results, it is necessary that there be no pockets or blow-holes between the waterproofing and the wall. If the surface to be waterproofed is at all rough, it is impossible to avoid these with either paper or felt, as they cannot be so pressed against the surface as to conform absolutely to its unevenness. Burlap is not elastic and has but little more flexibility than the felts.

The specification for the membrane would then be: "The membrane shall be a woven cotton fabric, which in its raw state contains no oils of any kind. It shall be thoroughly saturated with a natural bitumen, which bitumen shall fulfill the specification given above. No oils, petroleum residues or other bitumen solvents shall be used to liquefy the bitumen in order to produce this saturation, but it shall be accomplished entirely by pressure. It shall be elastic, having a stretch in any direction of at least 5 per cent without fracture. A 1" strip shall sustain a weight of at least 90 pounds. It must be proof against puncture by a stick with a base 1" square weighted to 90 pounds. It must be flexible at all temperatures between 0 deg. and 250 deg. Fah., and shall not flake or crack when folded back upon itself. It must be of such a nature as to readily conform to any unevenness in the surface to which it is applied, leaving no pockets, bridges, nor air holes."

Conclusion.

A waterproofing course laid with material which would comply with the above specifications would constitute a flexible and elastic blanket over the floor, which blanket would be unaffected by water, by the alkalies in cement, or by the acid impregnated

drippings that would come through ballast. This blanket would remain flexible at 10 deg. Fah., and would not crack or fracture because of vibration caused by a moving train. It would also be elastic at the same low temperature having a total stretch of at least 5 per cent without fracturing either the membrane or the plying cement.

VALUATION OF RAILROADS.*

The valuation of our railways can be divided into three main divisions: (a) The work to be done; (b) the time and expense involved, and (c) the benefit to be derived.

The Work to Be Done.

The act of Congress of March 1, 1913, requires us to ascertain and report the cost of reproducing new the railroad and other property of every railway company in the United States, and the cost of reproduction less depreciation. This requires that the railways furnish maps containing sufficiently complete information on which to base a valuation, and then requires that this information be verified by the government engineers.

The work is referred to as a "physical valuation," but it is more comprehensive than that. In fact, the law virtually requires, in short, a complete corporate and financial history of the properties and data on the earnings of the properties, the value of the properties to be based on all these facts.

Some problems are involved which have to be carefully considered. For instance, a section of the San Pedro, Los Angeles & Salt Lake R. R. was washed out entirely as first located and again when relocated and when rebuilt. And it is probable that government engineers would have located the road approximately the same as the engineers who did locate the lines—the logical route was chosen in both cases. The problem is to determine what, if any, allowance should be made for the first two locations. Other problems of like nature will be often encountered.

The Time and Expense Involved.

The country has been divided into five districts, by states, each containing approximately 50,000 miles of railroad, each district to have an organization of its own. I believe the field work should be completed in from four to six years from July 1 next; the actual valuation will necessarily lag somewhat behind this.

Based on state valuations, I would estimate the engineering work at \$15.00 per mile, and accounting and other features at \$10.00 per mile. Based on railway valuations, which range from \$40.00 to \$80.00 per mile, at least \$50.00 per mile will be required. I advised Congress not to enter the work unless prepared to expend \$12,000,000, and my opinion remains unchanged on the amount.

However, the capitalization of the railways aggregates nearly twenty billions of dollars, so that the valuation will be less than 1/20 of 1% of the values ascertained. If the valuation shows only a variation of 5% in the amount of capital on which the railways will be allowed to base charges, the amount involved will be one billion dollars, which would yield at 6%, \$60,000,000, or five times the entire cost of valuation, each year.

The Benefit.

It is a duty of our government within reasonable limits, I believe, to safeguard the investor, to see he is not hoodwinked in the original investment, and that the value of the investment be not destroyed. The additional security given to railway investments through this valuation will result to the advantage of both railways and investors.

The determination of a fair rate of return for the railways is a big problem, all just men maintaining it should be substantially the same on railway property as on the returns on private investment having the same incidents. In public utilities it is, with some important qualifications, comparatively easy to fix the rate. But railways are subjected to direct

* Condensed from an address by Honorable C. A. Prouty, Director of the Division of Valuation, Interstate Commerce Commission.

competitive conditions not present in most public utility problems. The rates of one railway therefore are bound up with those of another or of several others. In addition there is cross country competition; that is, competition for the business of the farmer situated between two lines of railroad. If the business is held, the rates to different destinations must be the same regardless of the financial necessities of either line. Further indirect competition is encountered, due to the price competition on products which the railroad transports. A coal dealer, although served by a single railway, must have rates sufficiently low to allow him to market his product, or the railway will lose all his business. The established rates are largely interdependent, and the rate established for one necessarily influences and sometimes absolutely determines the rate of all.

If the railroads tried to compensate for the low rate on competitive business, high rates would be charged non-competitive points, thus concentrating business into certain localities, which I think is undesirable. The problem of fair rates will not be entirely solved by valuation, but they will be immensely simplified.

There has come to be a deep-seated conviction that railways are over-capitalized, and it is vitally important that the general public be given data on the actual value of railroads. Part of a railroad is known to have been capitalized at \$8,000 per mile in Texas, and \$42,000 per mile in the adjoining state of New Mexico, this due to the laws in Texas specifying that the capitalization must not exceed the investment on the problem. On the other hand, the Pennsylvania R. R. has in 10 years put into its property east of Pittsburgh \$200,000,000 from earnings. These facts lead some to believe railroads are under-capitalized.

The development of investigations into the affairs of railroads now under fire, suggests that the valuation should be prosecuted with all vigilance and exactness.

CONCRETE POLES WITHSTAND STORM.

The extreme strength of the reinforced concrete telegraph pole has been demonstrated upon more than one occasion during violent storms, to which poles of the wooden type readily succumb. The most severe test ever inflicted upon them occurred during the blizzard last winter, from which they emerged intact. Perhaps the most striking example of their extreme durability as exemplified in this storm was in the case of the telegraph line of the Pennsylvania R. R., where a large number of reinforced concrete telegraph poles were exposed to the storm which swept over the Hackensack Meadows in the vicinity of the west entrance of the Pennsylvania tunnels leading into New York City. The company had erected many of these poles in recognition of their durable and stormproof properties. As is well known, the storm center was in and about New York City, and so violent was the wind, which reached a velocity of 70 to 80 miles an hour, and so great the accumulation of snow and ice that New York was practically isolated for a time, at least so far as above-ground telegraphic communication with Philadelphia was concerned. The company's telegraph line was out of commission for a long time and many of the wooden poles were broken down by the wind and their burden of snow and ice. In no case, however, did a reinforced concrete pole collapse. So severe was the stress that the wooden cross-arms upon some of these poles were broken, but the poles themselves remained intact. The absence of telegraphic communication cost the company many thousands of dollars, as trains were stalled and in some instances completely lost during the height of the storm. There was no way for the company to get into communication with the crews. It has been stated that had the entire line been constructed of reinforced concrete poles it would have saved the company a tremendous loss.

These poles are made of Portland cement concrete, reinforced with steel rods to take care of tensile strains. They do not rot as do wooden poles and never rust as is the case

with steel poles. At the present high price of timber, concrete poles are not prohibitive in first cost, and considered as a long-time investment are extremely economical. The Pennsylvania and other railroad companies are establishing their own manufacturing plants and it is likely that the next few years will witness a marked increase in production.

THE INTERPRETATION OF EXPERIMENTAL DATA.

(Part 2.)

By J. G. Van Zandt.

Note—In a previous article (page 116 in the March issue) the fundamental principles in the interpretation of data were set forth, and in the following article the practical rules of procedure will be outlined.

III. Practical Rules of Procedure.

(a) *Tests.* There are evident reasons why tests should be so conducted that the data observed may be easily reduced by proper methods. Much information may be available from observation which is not susceptible to mathematical treatment, and consequently is not of as great value as it would be had this been kept in mind while the tests were being made. It is highly important that all the factors entering into the result should be carefully noted and that the observations should be taken simultaneously. For this reason it is not sufficient that one observer on a test car take a reading in one place, and then go out and take one in another place, but all readings should be taken at nearly the same instant. For this purpose a combination of alarms may give different observers the instant at which the readings are to be taken, or all the observations may be recorded automatically by some mechanical or electrical connection. It is obviously necessary that all the factors be observed as one changing factor may cause a change in the result, and this change may be ascribed to another cause if the factor whose changing caused the difference is not included in the observation.

Among the most important items is the calibration of instruments used in each test, since any discrepancy made in this calibration is a factor of error in every observation made; and if this matter is not carefully taken care of the result may be considerably in error. It has been an unfortunately common custom to assume all gauges and instruments of measurement to be absolutely correct under all conditions, even for values outside the range for which they were designed. Of course this is a mistake, as nearly all instruments give results requiring adjustment, and the corrections should be made at all times, the amount being carefully determined by previous tests. The range of all the tests should be determined in advance and care should be taken to see that these limits are not exceeded at any time. The number and extent of tests also ought to be considered in advance and the same degree of accuracy and reliability be carried throughout the entire series of tests. It is obviously unreasonable to take some readings with great refinement while others are hastily observed or approximated. Generally speaking, most of the labor of compilation and reduction may be saved in the care and arrangement of the observations taken during the tests. The time taken in preparing uniform methods of observation will be well spent and will contribute liberally to the accuracy of the result.

(b) *Compilation and Coordination of Data.* Where tests are made involving observations at points distantly removed from each other, care must always be taken to see that, in compiling the results, the individual observations are properly coordinated. For example, in a train test some records may be taken in the locomotive and some in the caboose. For correct results these should not only be taken at the same time, but carefully numbered, and the time of day recorded for purposes of identification. When results are compared it may be found that there are not the same number taken at each end, and hence care must be taken to see that the correct locomotive records are coordinated with the caboose records taken at the same time. Errors of this nature creep into an investigation with remarkable frequency, and naturally increase the error of the result.

(c) *Correlation.* After the compilation of all the data is complete, then the results should be arranged in their numerical order so as to properly seriate them into classes for further study. For this purpose all variates which can be eradicated should be so treated by taking separate seriations at each value of the variate. For example, in a test for train resistance, the weight should be considered as constant, using only cars of one weight for one seriation, then of another for the next series of values, and so on. Similarly the speed may be used as constant, making seriations separately for a given weight and speed, and studying only those variates within the limits chosen. In this way many apparently contradictory results may be reconciled and fully accounted for. In Fig. 2, it appears that with variations of speed alone considered, train resistance is an uncertain quantity, but in Fig. 3, where the weight is equally considered, there are many reconciliations. Both of these diagrams were prepared by Prof. Schmidt from the same data, but in Fig. 3 the second characteristic is given due consideration. Hence, taking out all points of one weight and speed, we get a variation which should be seriated and studied alone. Having secured this seriation, then the mean of

be observed that the two characteristics are displayed as opposed to one another, one being given in the vertical column and the other in the horizontal column, and the number of variates having the two values in common is shown where these two values of the characteristics intersect. For instance, where a value of "—3" in X' and of "—2" in Y' intersect, there are 65 variates recorded (in other words, where the vertical column under "—3" intersects the horizontal column "—2" we find the number "65"). There were 2,000 observations taken as will be checked by the summation of the vertical column "f" or frequency, which is merely the adding of the numbers occurring in the horizontal column in which they are given. The deviations from the mean class are given in plus and minus, there being four classes given as negative or having less than the mean, and six classes with plus, or having more than the mean values. The standard deviations (σ_1 , σ_2) are given as 1.7195 and 1.7304 respectively and the constants v_1 and v_2 are found in the tabular arrangement by multiplying the frequency (f) by the departures (V-V_o). The "moment about the mean" or u_1 is found by subtracting v_1 (or $\Sigma (V-V_o) \div n$) from v_2 (or $\Sigma y^2 \div n$) and the final result

	X'	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6				
Y'	ARRAY	0	1	2	3	4	5	6	7	8	9	10	f	V-V _o	$\Sigma y'$	$\Sigma y'^2$
	TYPE															
-4	0	8	5	2									15	-4	60	240
-3	1	4	151	58	9	3							225	-3	675	2025
-2	2	2	65	154	96	28	7	1					353	-2	706	1412
-1	3		14	88	173	128	28	6					437	-1	437	437
0	4		5	27	119	153	77	26	3	1			411	0		
+1	5		1	7	24	92	101	52	11	9			297	+1	297	297
+2	6				8	16	58	48	16	7		2	155	+2	310	620
+3	7				1	8	20	18	17	9	5		78	+3	234	702
+4	8					1	3	5	3	2	2		16	+4	64	256
+5	9						1	3	3	2	2	1	12	+5	60	300
+6	10										1		1	+6	6	36
	f	14	241	336	430	429	295	159	53	30	10	3	2000			
													TOTAL			
	X'	-4	-3	-2	-1	0	+1	+2	+3	+4	+5	+6				
	$\Sigma X'$	-56	-723	-672	-430	1881	295	318	159	120	50	18	960			

$$V_1 = \frac{960 - 1881}{2000} = -.4605$$

$$r = 0.7911$$

Table 1.

these values may be found by formula (3) and the mode by formula (4), which latter will have a probable error which may be found by formula (5), and if it is within the degree of accuracy desired the value of this mode may be considered as representative of this set of variates. When a series of modes thus found is considered in relation to another variable, then the variation is seen to possess features not evident in the independent variates. It may appear that there is no relation between one and the other. In this case (as in all cases) it is best to determine what is the coefficient of "correlation in the variation."

The correlation of a variation is the measure of a relative change effected in one characteristic by corresponding changes in another.

The method of determining the coefficient of correlation is based upon a process of seriation and array of the variates, in which the frequency in one characteristic is combined with the frequency in another, and a summation of these frequencies is multiplied by their class deviations and divided by the standard deviations. The formula employed is as follows:

$$r = \frac{\Sigma (\text{dev } x \cdot \text{dev } y \cdot f)}{a \sigma_1 \sigma_2}$$

which may be stated as follows:

Summation products deviation of classes and the combined frequency, divided by product total number variates and standard deviation of both characteristics.

Table I is an illustration from an actual case showing the seriation of an array of data for the purpose of correlation. It will

or "coefficient of correlation" is found to be 0.7911, which indicates that about 80 per cent of the variation is due to changes in these characteristics involved in the investigation.

In a study of train resistance by the author, mentioned in RAILWAY ENGINEERING (July, 1911), it was found that the speed of the train influenced 45 per cent of the variation and the weight of the car nearly 55 per cent, indicating that these two factors have about the equal effect in changes in the values of this important factor in railway economies. Similarly, a study was made by the C. M. & St. P. Ry., and used in a case before a commission to show the effect of changes of operation on maintenance, but as the probable error was too great and coefficient of correlation too small to justify the assumptions made from the data, the railway was unable to establish the relationship to the satisfaction of the commission. If this coefficient of correlation is small it may be that a new factor of the variation might be discovered. For example, in the study of train resistance data, it was found that whenever a test was made during the first ten or fifteen minutes from the start of the trip that the results were invariably higher than those taken later under the same conditions of speed, etc. It was found by further test that this was due to the temperature of the journals being lower at the start and changing rapidly as the speed increased and the time elapsed. Hence a new variable was introduced which was always in evidence to some extent but chiefly at the start of each trip. Data taken within the first half hour of each trip should therefore be considered separately from that taken later. In any case, when the correlation reveals the fact that there are other factors of

$$\begin{aligned}
 &+971 \quad 6325 = \Sigma y^2 = V_2 = 3.1625 \\
 &-1878 \quad 2000 = n \quad V_2 = .2056 \\
 &V_1 = \frac{-907}{2000} = -.4535 \\
 &u_1 = 2.9569 \\
 &u_2 = 1.7195 \\
 &u_3 = 1.7304
 \end{aligned}$$

large influence involved, these should always be dealt with separately, as just indicated, and thus eliminated from the variations at hand.

(d) *Final Results.* As the final result should be in form for practical use it will be necessary to combine the seriesations of the above variates into diagrams which may be superimposed or plotted together so that any desired condition may be taken and a resultant determination be readily found. For this purpose a number of curves on a coördinate diagram may give three conditions from which a constant may be found, which constant, combined with two other variations of conditions in a second diagram, may give a second constant. Thus, any number of varying conditions may be combined. In order to facilitate rapid and accurate use, these diagrams may be plotted adjoining each other on one plate or on translucent sheets which may be superimposed for graphic determinations. Where certain curves intersect on two diagrams, thus superimposed, a third condition may be considered by another superimposition of a sheet and any number of conditions combined for a final result.

It must be borne in mind, however, that it is not to be expected (by using these methods) that one may arrive at a simple formula or integral result which shall be the exact and established average, which should always be obtained if conditions were properly taken. It must be remembered that any single variate has a very large probable error and the results obtained by these approved methods are more nearly indicative of the true conditions from which a basis may be derived for the solution of practical problems. *The principles involved will invariably appear from a study of data in this manner which could not be ascertained by averaging variates.* Taking Train Resistance, for example, again; the general principle that Train Resistance varies with speed is so well established by this method of investigation that there should be no doubt of this general principle. On the contrary many problems of Railroad Economics have been based upon the erroneous assumption that the speed had no effect upon the train resistance. Evidently the averaging methods were used in arriving at this result, which indicates the unreliability of any but scientific statistical methods.

(e) *Conclusion.* For reference and simplicity of use it is desirable that the above methods be given in concise and workable form and for this purpose the following is suggested:

(1). Classify all results and separate those including the same variates.

(2). Taking each condition separately eliminate all variates but two by using separate constant values for each condition observed.

(3). Plot these diagrammatically for observations and complete for each one the mean, median and mode, plotting the same on the diagram. For example, if a series of 500 tests for Train Resistance at 15 miles per hour, on cars of 45 tons, the mean or average Train Resistance was found to be 4.54 pounds per ton, and the median 4.51 pounds per ton. The mode therefore is,

$$M = 3m - 2A \text{ or,}$$

$$M = 3(4.51) - 2(4.54) = 4.45.$$

Taking the same cars at 16 miles per hour another mode is found and finally a series of modes are plotted, giving a theoretical

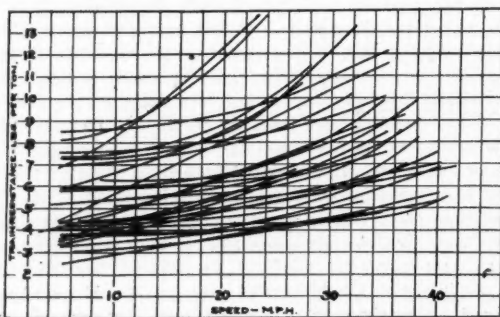


Fig. 2.

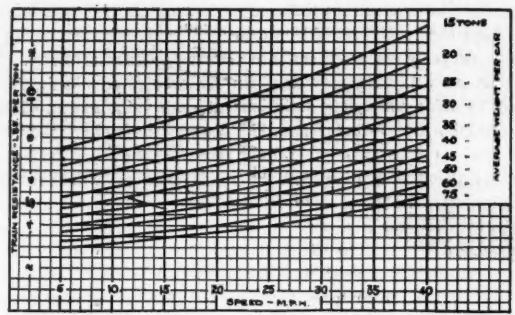


Fig. 3.

curve of most reliable values. Seriate the values and compute the standard deviations and probable errors.

(4). Correlate and determine coefficients of correlation.

(5). If coefficients are satisfactory, proceed by computing the mode for each constant value of the other variate and then determine the probable error of each.

(6). Through these points plotted on a coördinate diagram, draw a curve, which represents the average result of the data at hand and compute the mean of the probable errors which will represent the average error of the entire determination.

For approximate results, number (4) may be omitted and the mean values only be used in number (3). Further, the diagram may be taken in sections and the mean of each section used, the sections being taken clear across the diagram vertically or horizontally. The sections should always be chosen with comparatively small limits and care should be taken to so locate these limits as to give as "normal" a distribution of the plotted points as possible.

DRIFT FENCES.

To the trackman, drift fences suggest snow fences, and it is therefore interesting to note that drift fences are used by the national government in order to control the movements of sheep and cattle grazing under permit in the national forests. These fences are not enclosures, but generally extend for long distances across the country, like railway snow fences; the drift fences are to prevent cattle from going in certain directions, or "drifting," to use a cattleman's expression.

In the Dixies forest of Utah a drift fence five miles long was constructed to protect the water supply of the city of St. George.

In the Fishlake forest of the same state a drift fence $4\frac{1}{2}$ miles long has been constructed to separate cattle and horses. Cattle are kept on the north to prevent them eating larkspur, which is poisonous. Horses will not eat larkspur. This fence decreased the deaths of cattle, due to larkspur, from 30 to 5 per month. It is estimated that the saving will equal \$4,000 per year, while the fence cost only \$750.00. In some places the benefits to the government are so great that they stand the entire cost of the fences. In other sections a division of the expense is made between the stockmen and the government, the apportionment in case of dispute being arbitrated with the Boards of the sheep or cattle owners' Associations, of which there are a number.

Wm. P. Carmichael and H. M. Cryder announce the organization of THE CARMICHAEL-CRYDER COMPANY, Engineering Contractors. Associated with them as chief engineer is C. B. Freeman, formerly Chief Engineer of the Wm. P. Carmichael Co. The scope of work of the new organization will be as heretofore with the Wm. P. Carmichael Co., the design and construction of Reinforced Concrete Structures, with added features whereby, through improved methods, uniformity is assured, and the field of application extended. The general offices are located at International Life Building, St. Louis.

The Public Belt, of New Orleans, has ordered two locomotives from the Baldwin Locomotive Works.

CONCRETE



DEPARTMENT

Encasing Structural Steel With Concrete

NOWADAYS a great many structural steel bridges are encased in concrete as a protection against corrosion, especially in places where reinforced concrete structures are out of the question on account of clearance requirements, long spans and similar conditions.

When structural steel is encased in concrete the steel is designed to carry the entire load, the concrete acting simply as fire- or rust-proofing. In order that the concrete may act as an effectual rust preventative it is absolutely necessary that it be of a dense mixture and free from cracks. Now concrete does not adhere readily to flat surfaces of structural steel, and more or less trouble is always experienced in preventing it from cracking and loosening away from the flanges of girders, beams, etc., unless they are wrapped with a mesh or fabric to provide a grip for the concrete.

Sometimes, in addition to wrapping the flanges of structural members with mesh, the webs of deep members are punched at intervals of a foot or so both horizontally and vertically and hooked bars inserted which tie the concrete to the girder. The punching of a great number of holes and the insertion of hooked bars in girders, as was done in the construction of the Montgomery street bridge, Philadelphia, described on another page, is without doubt a rather expensive proceeding. It would seem that the use of a line or two of such hook bars, and the complete wrapping of the member with wire mesh anchored to the line of hook bars would be more effective and cheaper than the method just described. The objection to the use of wire mesh completely enveloping a girder or beam is that difficulties may be encountered in obtaining a concrete free from voids or stone pockets, on account of the tendency the coarse aggregate has, of banking up against the wire fabric if the same is of close mesh. This difficulty can be removed by using a 3 or 4-inch square mesh with fairly heavy longitudinal wires and light cross wires, the heavy wires to extend up perpendicular to the flanges of the beams.

Another consideration which is of utmost importance in the design of the steel work is the deflection under full load. Ordinarily in steel design the limiting deflection is 1/360th of the span, which is the maximum deflection allowable for plastered ceilings if cracking is to be prevented. Now if a concrete member or steel member encased in concrete deflects 1/360th of the span, the concrete will be seriously cracked, which at once defeats its purpose and tends to cause it to spawl off, unless held by the wire mesh wrapping of the steel. Steel encased in concrete should be designed primarily for a limited deflection (of say 1/600 of the span), and not for strength alone, if the best results are to be obtained. In conclusion it can be said that structural steel beams and girders if designed with more than ordinary stiffness, wrapped with wire mesh and encased in dense concrete, will be as completely protected against corrosion as it is possible to make them.

Sand for Concrete

THE suggested specifications for sand for mortar and concrete taken from Bulletin No. 70 of the Engineering Experimental Station of the University of Illinois and given on another page in this issue, fill a long felt want. It is worthy of mention that the stereotyped phrase "clean, sharp sand" is omitted in these specifications. The tests forming the basis for this bulletin showed that sharpness or angularity of the sand grains exerted little or no effect on the tensile strength of the mortar, which judging from specification is contrary to the belief of many engineers.

"In one particular case, a sand with very sharp glass-like grains gave only 70% as much strength as the Ottawa standard sand with its spherical dull surfaced grains, although the former was better graded and the two samples were practically identical in composition and sharpness. In compression, the sharp sands may show a slight advantage due to the interlocking of the angular grains; but it is evident that such action is insignificant as compared with the resistance to displacement of the grains afforded by the bond between them due to the adhesion of the cement to their surfaces, hence the strongest mortars (and concretes) are invariably those in which the cement most readily adheres to the sand grains, which are those with worn and roughened rather than angular surfaces. Mortars made of round-grained sands will compact more readily than those of sharp sands; hence such mortars in place are likely to be more compact and dense, which conduces to greater strength. The usual requirements of specifications that sands for mortar and concrete shall be sharp is not only useless, but may even be detrimental and should therefore be omitted."

The above quotations should be sufficient to convince the "old guard" that angularity is not a necessity in sand, and that the words "clean, sharp sand" alone, do not mean better concrete.

COLFAX-LARIMER VIADUCT, DENVER, COLO.

Work will soon be commenced on the Colfax-Larimer viaduct in Denver. This X-shaped structure is remarkable, both for its size and shape. The main portion, 5,544 ft. long on Colfax avenue, extends from Federal boulevard to Osage street. At First street the Larimer street branch, 2,938 ft. long, crosses the Colfax avenue branch. The total length of the viaduct is 8,482 ft., consisting mainly of reinforced concrete spans. Several steel spans will be used over the South Platte River and the railway tracks. The total cost of the structure, exclusive of the right-of-way will be about \$800,000, to be paid for jointly by the city, the county of Denver, the street railway and the several railways operating under the structure.

The Great Northern Railway has just completed a considerable number of snow sheds in the Cascade mountains to protect its tracks against slides. The sidewalks next to the upper side of slope are of reinforced concrete designed as counterpart walls, or rubble concrete gravity walls. The roofs and walls on the down slope side of track are constructed of wood.

REINFORCED CONCRETE TRESTLE FOR OVERFLOW CHANNEL OF THE CUMBERLAND RIVER BRIDGE, I. C. R. R.

Detailed Description of a Reinforced Concrete Trestle 24 Ft.
High and 100 Ft. Long, Composed of Built-in-Place Bents
and Premolded Floor Slabs of 14 Ft. 6 In. Span.

By A. M. Wolf, C. E.

General Description of Site and Conditions to Be Satisfied.

The reconstruction of Bridge J200-59 over the Cumberland River at Cumberland River, Ky., on the Kentucky division of the Illinois Central Railroad, between Paducah and Central City, was necessitated by the desire to run heavier locomotives between the points named. This is in line with the policy of this road to increase the weight of locomotives used, on practically all lines.

The old bridge consisted of a single track, 281 ft. 11 in. draw span built in 1890; a 178-ft. fixed span built in 1890, two fixed spans 177 ft. 6 in. long built in 1903, and a timber trestle approach 397 ft. long next to the draw span. The fixed spans built in 1903 were designed for a loading nearly equivalent to Cooper's E-50, and therefore did not require renewal. The draw span and other fixed span were designed for a much lighter loading; the former had been reinforced in 1898, but these spans were still too light for the contemplated traffic equivalent to about Cooper's E-55, and they, therefore, had to be renewed. It was also decided to fill practically all of the timber trestle approach and provide an overflow channel

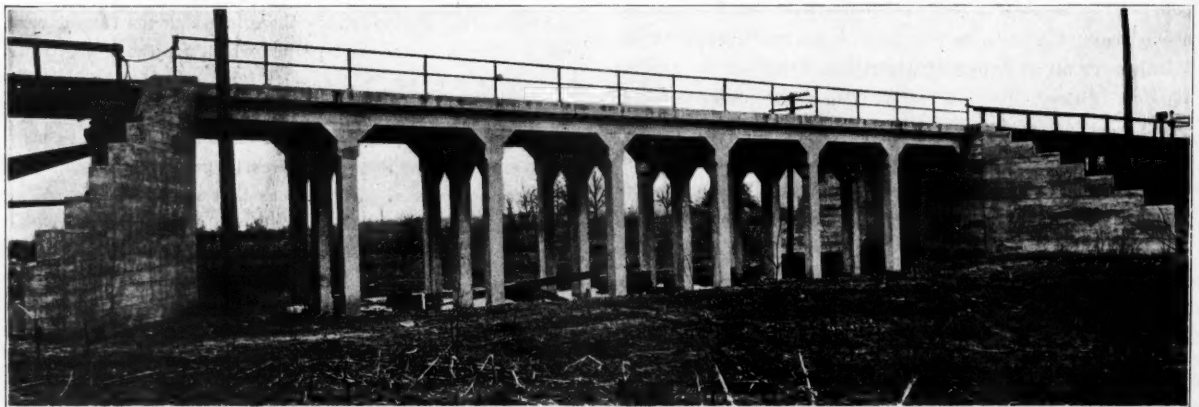
draw span was completed in February, 1912. The concrete trestle was built by the masonry gang at such times as the work was shut down on the piers for steel spans on account of high water, without interfering with the old trestle or delaying traffic. This was done as shown in Figure 2, by placing the new concrete bents between the old wooden bents and keeping the tops of the former considerably below the old stringers. The bents were built in place, connected by continuous side girders, and after all bents were completed the deck slabs, weighing about 26 tons, which had been cast in a yard some distance beyond the trestle, were swung in place between girders by a derrick car after removing the old trestle.

General Design.

As previously stated, the trestle consists of six 3-post bents of reinforced concrete resting on continuous transverse footings, and tied together at the top by cross girders and longitudinally by continuous side girders, with center to center spans of 14 ft. 6 in. and a height of 24 ft. The end spans rest on plain concrete gravity abutments. The space between the side girders was filled by premolded slabs 2 ft. thick, upon which is placed the ballast and track. Figure 3 shows the general design of the trestle.

Loadings, Materials and Stresses.

The structure was designed for a live load due to a standard engine which is practically equivalent to Cooper's E-55, and the dead load of the structure and ballast. The bearing on the soil for piers is $1\frac{1}{2}$ tons per sq. ft. for the loadings given, and $1\frac{1}{4}$ tons per sq. ft. for abutments. These low pressures



Reinforced Concrete Trestle Cumberland River Bridge, I. C. R. R.

about 228 ft. away from the swing span, but building a concrete trestle 100 ft. long. (See Figure 1.) Under ordinary conditions of flow this extra channel is not required, but in order to safeguard the fill during extreme high water it was absolutely necessary, since the high water mark is only 10 ft. below the base of rail on the bridge.

The work of reconstruction was begun on the fixed span only in June, 1909, since the War Department would allow the replacement of only one span at a time. However, on account of the destruction of one set of falsework, erection was not begun until April, 1910, and completed in May. The

were used on account of the soft alluvial soil encountered.

The concrete for foundations and abutments was a 1:3:6 mixture, while all other concrete was a 1:2:4 mixture. The slabs were designed for unit stresses of 16,000 lbs. per sq. inch for steel and 700 lbs. per sq. inch compression on concrete. Corrugated bars of high carbon steel were used for reinforcing for the entire structure. The yardage of concrete required for the trestle was as follows: (1) Reinforced concrete: Slabs, 88 cu. yds.; footings, 64 cu. yds.; neatwork, 100 cu. yds.; (2) Plain concrete for abutments, 490 cu. yds., making a total of 742 cu. yds.

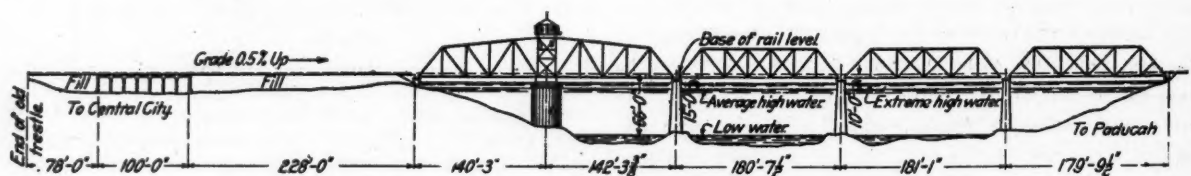


Fig. 1.—General Elevation, Cumberland River Bridge, I. C. R. R.

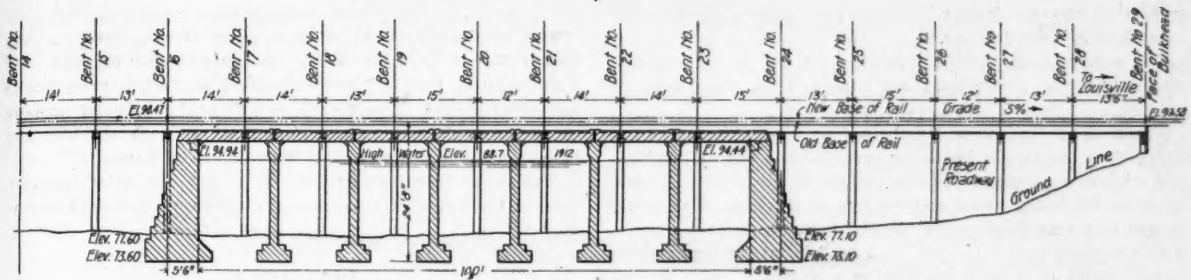


Fig. 2.—Location of New Structure, With Respect to Old Trestle Bents.

Details of Design.

Trestle Bents—The pier footings 18 ft. long, 3 ft. thick and 6 ft. wide were carried down about 4 feet below the general ground line. In order to save material, the footings were stepped, the upper course being 4 ft. wide and 1 ft. thick. These footings are reinforced longitudinally in top and bottom to provide for the bending stresses due to the three-post concentrations. Transverse distributing and spacing bars are used in

bars, tied with $\frac{1}{2}$ -in. diameter hoops on 8-in. centers. The vertical bars extend up into the longitudinal side girders or parapets, and are bent out at 45 degrees parallel to side of girder. The center column is reinforced with six $\frac{3}{4}$ -in. sq. bars, the two middle bars extending up into the cross girder to a point near the top, while the corner bars are bent out at about 45 degrees into the cross girder. The bars are tied with $\frac{1}{2}$ -in. hoops, 8-in. centers. All vertical bars extend well into the

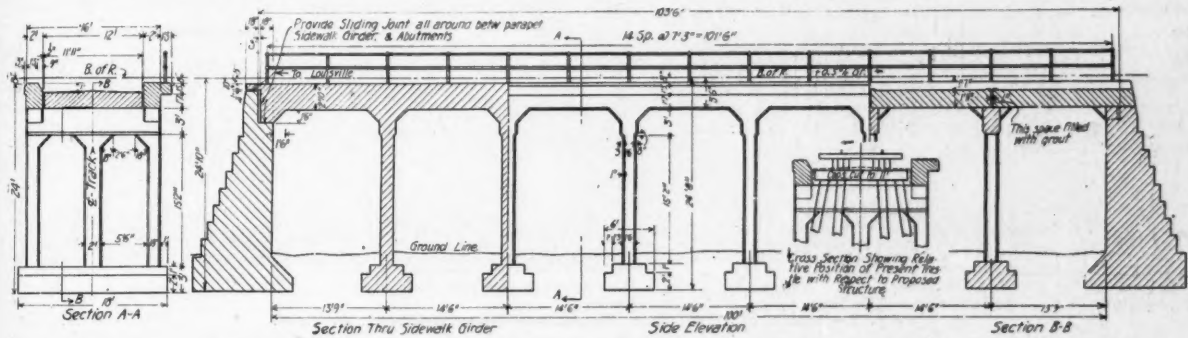


Fig. 3.—General Design Concrete Trestle—Cumberland River Bridge, I. C. R. R.

the bottom of footing. The main bars in bottom were placed 6 in. above bottom of slab, to insure their being properly protected, while the top bars are 3 in. below top of footing slab. The details of footings are shown in Figure 4.

The reinforced concrete bents consist of two exterior columns, or posts, 18 in. square, spaced 14 ft. 6 in. centers, and a 1 ft. 6 in. by 2 ft. post between, directly under center line of track. The outer columns are reinforced with four $\frac{3}{4}$ -in. sq.

footings. The columns are filleted to the cross girders with 18-in. 45 degree fillets. (See Figure 4.)

At an elevation of 15 ft. 2 in. above the top of footings the columns are connected by a cross girder 2 ft. wide by 3 ft. deep, reinforced as shown in Figure 4 with six $\frac{3}{4}$ -in. sq. bars in bottom, two straight and the others bent as shown. The top reinforcement consists of four $\frac{3}{4}$ -in. sq. bars, straight, with $\frac{3}{4}$ -in. distributing bars 1 ft. 6 in. long, spaced 12 in.

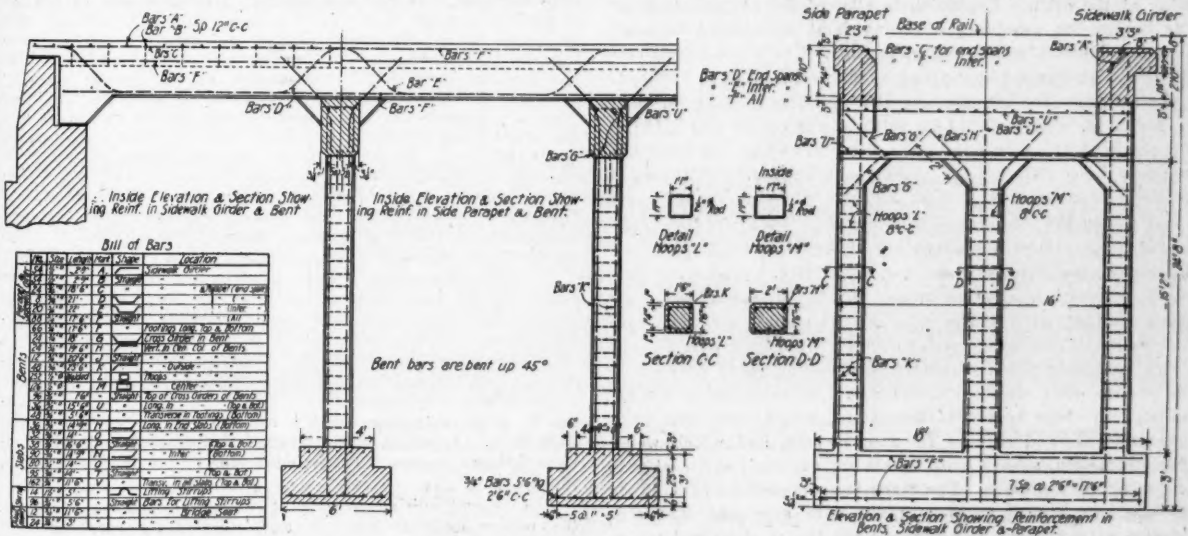


Fig. 4.—Details of Trestle Bents Cumberland River Bridge, I. C. R. R.

centers above the former. These cross girders support the deck slabs described below.

The column bars have a protection of $2\frac{1}{2}$ in. of concrete while the cross girder bars are placed 3 in. from face of concrete.

Longitudinal Girders or Parapets—The floor slabs not being fastened to the trestle bents, necessitated the use of longitudinal girders or parapets to tie the entire structure together, so as to effectually resist stresses due to traction. The girder on one side acts simply as a tie and parapet, while the other, with a projection of 1 ft. 3 in. by 1 ft. 3 in. at the top, making a total width of 3 ft. 3 in., acts as a sidewalk. The parapet girder, 2 ft. wide by 2 ft. 10 in. deep, with a projecting coping 1 ft. 3 in. deep, is reinforced with $\frac{3}{4}$ -in. bars; three straight in top lapping about 2 ft. over the bents, and two straight and two bent in bottom, the bent bars being bent in easy

Comment.

This structure is an excellent example of reinforced concrete trestle design, so constructed as to allow of easy erection with little delay of traffic. The combination of built-in-place trestle bents and premolded deck slabs is a type of reinforced concrete construction which is finding great favor in track elevation and reconstruction work similar to that described herein.

The writer is indebted to Mr. A. S. Baldwin, chief engineer, Illinois Central R. R., for plans, photograph and data use in this article.

NEW BOOKS.

SYMMETRICAL MASONRY ARCHES. By Malverd A. Howe. Second edition, revised and enlarged. Cloth 6x9 inches, 245 pages illustrated with figures in text and folding plates. Published by John Wiley & Sons, New York. Price, \$2.50 net.

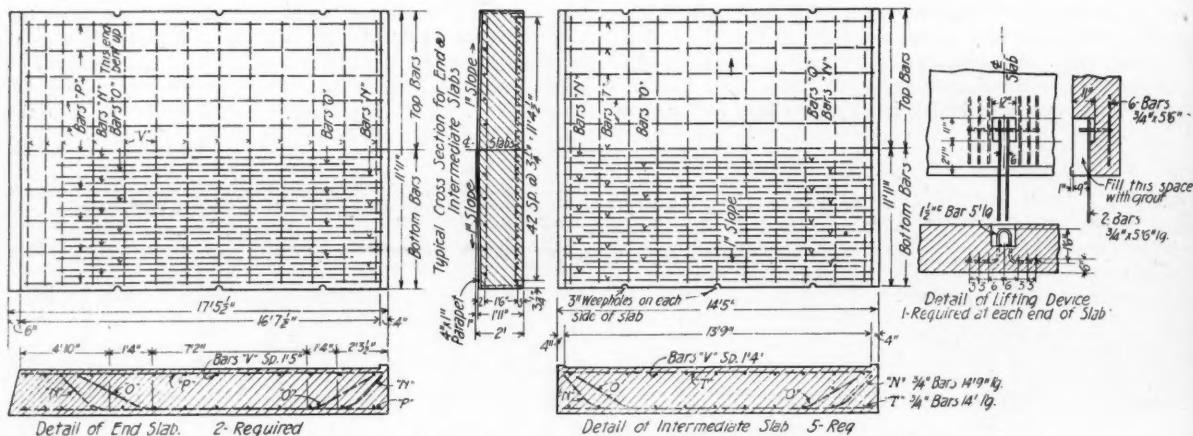


Fig. 5.—Details of Deck Slabs, Cumberland River Bridge, I. C. R. R.

curves to the top of girders over bents. These girders, tied to the bents by the projecting column bars, were cast continuous without expansion joints, and no construction joints were allowed over supports. The sidewalk girder is reinforced in a manner similar to the parapet girder, with some additional transverse and longitudinal bars to reinforce the sidewalk projection. At the edge of this projection is a two-rail gas pipe hand rail, 3 ft. 6 in. high. The end girders rest on plain concrete abutments with stepped backs and vertical faces, having a straight wing wall at one end and a splayed wing at the other. Expansion is allowed for at both ends of the bridge, by providing a sliding joint all around between parapet sidewalk girder and abutments. The edges of all columns and girders are chamfered, as shown in detail in Figure 4.

Deck Slabs—The intermediate deck slabs are 14 ft. 5 in. long, 11 ft. 11 in. wide, 1 ft. 11 in. thick at the center and 1 ft. 10 in. thick at the sides, the 1-in. slope providing for drainage to weep holes through the slabs at both sides. At the ends of slabs is a 4-in. curb 1 in. high, to prevent seepage from getting into the 1-in. grout joint between slabs.

The slabs are reinforced with forty-three $\frac{3}{4}$ -in. longitudinal bars at $3\frac{1}{4}$ -in. spacing in bottom, with $\frac{3}{4}$ -in. distributing bars at 1 ft. 4 in. centers transversely above these, with the same number directly above in top of slab under the longitudinal top bars, which are spaced 1 ft. 1 in. centers. Every third longitudinal bar in bottom is bent up on an easy curve to provide some shear reinforcement. (See Figure 5 for details.) In order to move these slabs, which were cast in a yard and allowed to cure for four months, and which weigh 26 tons, $1\frac{1}{2}$ -in. square hook bars were anchored and cast into each end of the slabs. The slabs were loaded on cars, taken to the site and swung into place with derricks. The side girders extend about a foot above the top of slabs and act as parapets to retain the ballast.

A book which presents in a simple form the method involved in designing masonry arches in accordance with the elastic theory. In this second edition much of the text has been rewritten and considerable new material added. The materials and conditions of construction of masonry arches are rather uncertain and upon this Mr. Howe very properly justifies his stand that somewhat approximate formulae and methods are accurate enough and being much easier of application are to be preferred to the more rigid method.

The book opens with a nomenclature and definitions and general relations of stresses in arches. Chapter 1 deals with the fundamental formulae for arch design, while the next two chapters give formulae and general treatment for design of symmetrical arches fixed at the ends, for both vertical and horizontal loads. The third chapter consists of examples showing the application of the formulae and methods advanced in the previous chapter. Two examples, one a granite masonry arch and the other a reinforced concrete arch of the Thatcher type are worked out in complete detail, the computation for the latter being arranged in tabular form so that they can be easily followed. Then again this method allows of the subdivision of the numerical work so as to have two or more computers working on them at the same time. This is a distinct advantage of the method and one to be commended. A few typical arches are illustrated and described in chapter 5. The physical properties of stone and concrete are given in Table I of Appendix A., while Table II gives data regarding about 600 masonry arch bridges arranged according to span. Arch coefficients for use in the transformation of dimensions in symmetrical rib arches; with tables of coefficients for 20 arches of different proportions make up Appendix B. The next Appendix gives formulae for the symmetrical fixed arch when the origin of the co-ordinates X and Y is at the crown, while Appendix D gives formulae for the solution of the unsymmetrical fixed arch. Appendix E on internal temperature range in concrete bridges is based on Bulletin No. 30 of the Iowa State College.

This second edition is a most valuable reference work for the bridge designer and we can unhesitating recommend it to all desiring such a work. The tables of data on masonry arches which have been built is invaluable to any designer.

MONTGOMERY STREET BRIDGE, PHILADELPHIA.

An Overhead Highway Bridge Composed of Steel Plate Girders Encased in Concrete.

By Jonathan Jones, Assistant Engineer, Bureau of Surveys, Philadelphia.

General.

The city of Philadelphia completed, about the end of the year 1913, a highway bridge on the line of Montgomery street over the Connecting Ry. (Pennsylvania R. R.) which well illustrates the type of bridge developed in that city for crossing steam railroads, where limited headroom prevents the use of a plain or reinforced concrete arch. It will be observed from the cross section drawing that the entire frame-work is of structural steel, encased in stone concrete of a minimum thick-

crossing being about 50 deg., the length of the two main girders is 72 ft. 8½ in. The girders for the two adjacent spans vary from 31 ft. to 46 ft., the supporting columns being forced into irregular positions by the presence of curved siding tracks and, on one end, of an old sewer. At each end the side slope is bridged by girders varying from 23 ft. to 33 ft. span, it proving more economical to build this additional area of bridge deck than to build concrete abutments to retain the fill. The total length of the bridge deck on center line is about 220 ft.

The reactions from the abutting ends of girders are carried through reinforced concrete columns to foundations in soft rock, below the sub-grade of the railroad. The column reinforcement consists in all cases of four 6x6 in. angles riveted together in "star" shape. The concrete encasement is 3 ft. 6 in. square, except for the four main columns, adjacent to the main

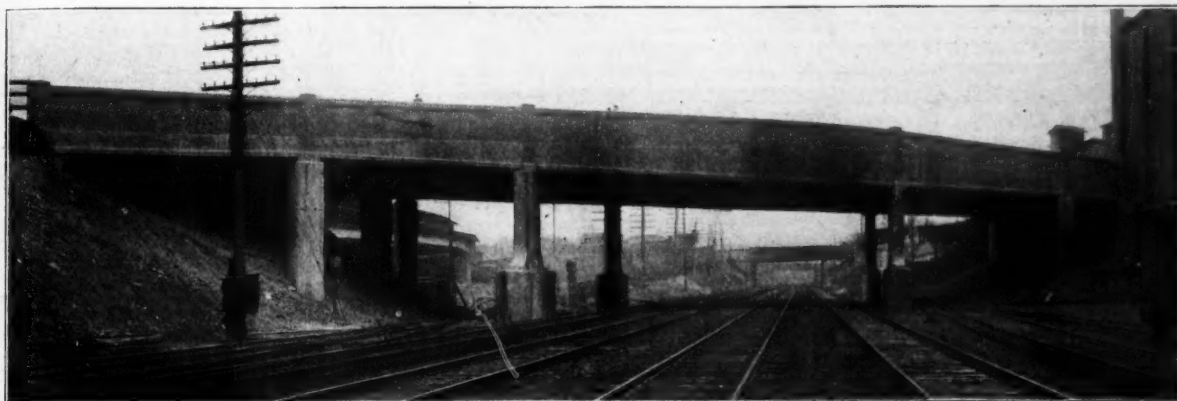


Fig. 1.—Montgomery St. Bridge—Philadelphia, Pa.

ness of 3 in. to prevent deterioration from atmospheric action and from the chemical and mechanical effect of the locomotive blast, and to obviate the necessity for painting and other expensive maintenance.

Details of Design.

The bridge is 56 ft. c. to c. of main girders, the cartway being 34 ft. and each sidewalk 11 ft. The curbs line up with those on the street approaches, and the width of 34 ft. is established to provide four lines of travel, two (future) electric car lines in the middle with one line of vehicular travel on each side. Main girders on the curb lines, projecting above

tracks, these being 3 ft. x 7 ft., the long dimension parallel to the railroad. These four columns are flared out to a length of 20 ft. for 6 ft. above the tracks, to serve as substantial collision piers in case of a derailment.

The rising grades (3½%) of the street approaches are prolonged onto the bridge and joined with a convex vertical curve of 800 ft. radius. The concrete encasement for the main girders, forming the parapet and handrail, is kept at a constant height of 3 ft. 10 in. above the sidewalks so determined. This consideration locates the top of the steel girders, and the required clearance (20 ft.) over the top of rail establishes the underside. The webs and main girders accordingly vary from

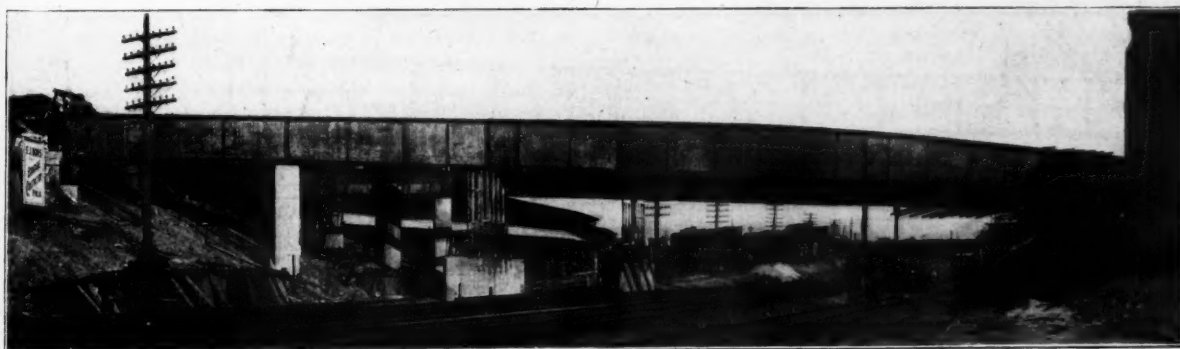


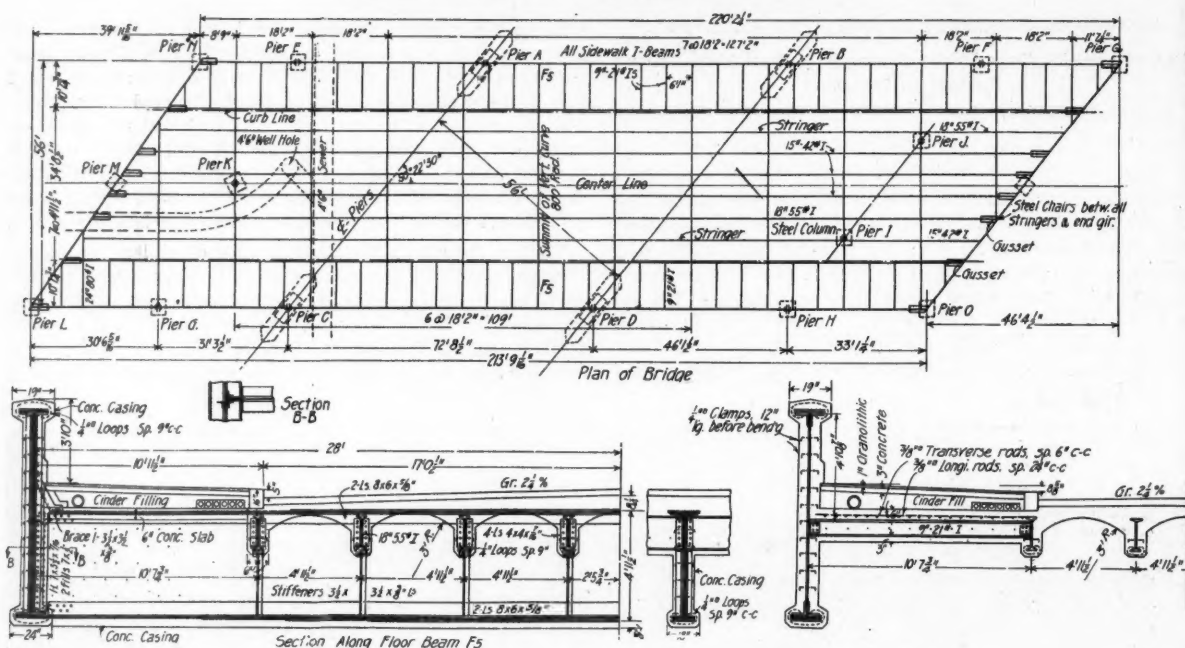
Fig. 2.—Plate Girders, Montgomery St. Bridge, Before Being Encased.

the sidewalks, would cheapen the bridge by shortening the floor beams, but are purposely avoided in Philadelphia as destroying the beauty of the broad, open deck and producing on pedestrians an unpleasant sense of constriction in a narrow channel.

The main span clears four railroad tracks, and the angle of

69 in. at the end to 109 in. at the summit. The two main girders, 72 ft. 8½ in. long by 9 ft. 1 in. back to back of angles, weigh 22 tons each. The details of these girders are shown in Fig. 4.

The main transverse floor-beams are spaced 18 ft. 2 in. apart.



The cartway is carried on eight lines of 18-in. I-beam stringers, 4 ft. 11½ in. c. to c., framed into the floor-beams; in each sidewalk panel, two 9-in. I-beams are framed transversely between the main girder and the first 18-in. stringer, thus providing a support about every 6 ft. for the sidewalk slab.

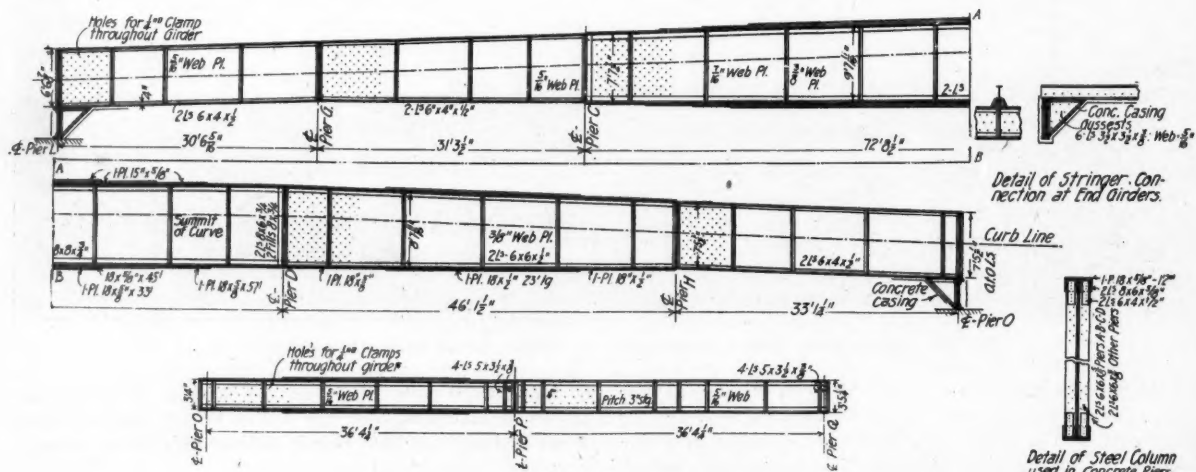
The cartway paving (asphalt) is supported on concrete arches of 6 in. crown thickness, sprung between and completely encasing the 18-in. stringers. The 6-in. rod-reinforced sidewalk slab is placed low enough to take the thrust from the cartway arches, and the space between this slab and the 4-in. granolithic-surfaced pavement slab is filled with cinders, providing a place for electrical ducts, gas mains and other public service structures.

Loadings.

The live-load assumed on the cartway is a 40-ton trolley car (four axles) or a 27-ton tank car (two axles) on each trolley track, or a 20-ton load on one axle, wheels 5 ft. c. to c., in any position. Impact is added to the street railway loads. The main girders are designed for 100 lbs. live load per square foot of cartway and sidewalks, plus 1,200 lbs. per lineal foot of bridge for additional live load on the two tracks.

Details of Concrete Encasement.

To secure the concrete encasement in position, the steel was left unpainted, and was scraped and cleaned before concreting. All webs were punched about 12 in. on centres throughout, for clamps of ¼-in. square steel, and loops of the same material, 9 in. on centres, were shaped to all flanges. The web encasement was at least 12 in. thick, and over the flanges at least 3 in. of concrete was required. Broken stone concrete of a 1-2-4 mixture of sloppy consistency was used, and care was taken to force out all entrained air, and to concrete the flanges from one side of the beam so that the air was forced ahead of the concrete and no voids were left in the under surface. The forms were hung on ½-in. round bolts. Two bolts, one on each side of the steel beam, pass through a 4x4-in. wooden crosspiece about 12 in. above the beam, and a 4x4-in. vertical piece, tapered on the bottom, resting on the beam flange carried the load from the 4x4-in. crosspiece at its middle point. (See Fig. 5.) The bolts were wrapped in tar paper to permit of withdrawing them when the forms were slacked, and the tapered wooden piece was then taken out, leaving a small hole to patch in the concrete, over the top flange.



The showing faces of the concrete encasement of the main girders were scrubbed with wire brushes and water, about 24 hours after concreting, to remove the film of mortar and expose the aggregate. The latter is a $\frac{3}{4}$ -in. stone of predominating blue color and gives a warm and rugged texture, which is very satisfactory for a bridge of simple, heavy proportions.

Cost.

The bridge was completed in eight months, one of which was lost through a carpenters' strike. The cost was \$49,426, or \$3.86 per square foot. The plans were prepared and the con-

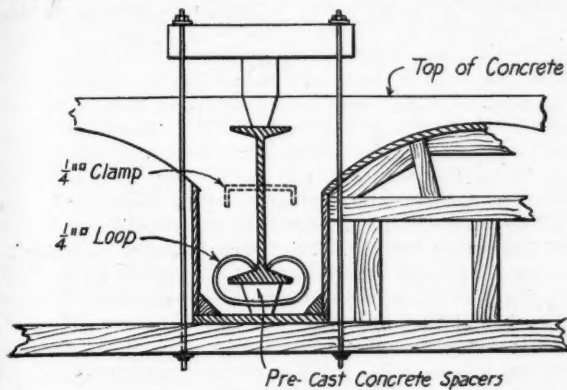


Fig. 5.—Details of Form Supports for Encasement of Stringers.

struction controlled by the bridge division of the Bureau of Surveys, George S. Webster, chief engineer; F. J. Boas was the general contractor, and the McClintic Marshall Construction Co. furnished and erected the steel work.

SPECIFICATIONS FOR SAND.

Abstract from Bulletin No. 70, Engineering Experiment Station, University of Illinois, by C. C. Wiley, entitled "The Mortar-making Qualities of Illinois Sands."

Need for Definite Specifications.—It is generally acknowledged that the specifications most frequently used for sand are inadequate in that they are too brief or too indefinite to secure the desired results. Recent specifications have overcome these defects in some respects, but most of them are objectionable in that they are too inflexible, *i. e.*, fail to allow variations in the quality of the sand to meet varying conditions or different requirements, or else by placing undue stress on some particular requirement bar from use sands which would prove entirely satisfactory. The following specifications have been prepared with the idea of giving this necessary flexibility, and at the same time of making them sufficiently rigid. It is not intended, however, that these specifications should be used indiscriminately for all purposes but rather that they should serve simply as a guide in preparing the specifications for any particular piece of work. In preparing these specifications both the specifications proposed by the national engineering societies and the results of the test described in this bulletin have been taken as guides.

Definitions of Sand and Screenings.—The term *sand* shall be understood to mean natural sand which will pass, when dry, a screen having $\frac{3}{4}$ in. clear openings. Similar material which is the product of artificial crushing shall be known as *screenings*, and shall conform to the specifications for sand.

Suggested Classification of Sands.—Sands shall be classified as No. 1, No. 2, No. 3, plastering sand, and grout sand, the several grades being suitable for the following classes of work:

No. 1 sand is required in reinforced concrete and in other work requiring a mortar of maximum strength and density.

No. 2 sand is required in work not demanding maximum strength or density but still requiring a mortar of high quality.

No. 3 sand is that required where high strength or density are not controlling factors.

Plastering sand is that for use in ordinary plastering over masonry, concrete, and wood or metal lath. Either No. 3 sand or plastering sand is of high enough quality for use in lime mortars.

The latter sand should be used where the thickness of the mortar joints is such as to require grains of small size.

Grout sand is that for use in pavement fillers and other work requiring a thin, smooth, free-running grout.

Suggested Specifications for Sand.—The author offers the following specifications for the various grades of sand according to the above classification. These specifications are based primarily upon the tests described in this bulletin, but it is hoped that they may be useful in preparing specifications for masonry work in general.

Specifications for No. 1 Sand.

Composition.—No. 1 sand shall consist of grains from hard, tough, durable rocks, and be free from soft, decayed, or friable material.

Cleanliness.—The sand must be free from lumps of clay, loam, or other foreign material. It shall not contain more than 2 per cent by weight of finely divided clay, loam, or other suspended matter when tested by washing in such a manner as to remove all such material without removing any of the finest sand; *provided*, that if the strength of the mortar made from the sand is greater than 110 per cent of the strength of a similar mortar made with standard Ottawa sand, the amount of suspended matter may reach 3 per cent. This suspended matter must not form a coating around the grains to such an extent that such coating is not entirely broken up and removed from the grains by sprinkling with water or in the mixing of the mortar or concrete. The sand shall be free from oily or greasy matter in any form and must contain no organic silt.

Roughness.—The grains shall have rough, unpolished surfaces to which the cement paste will readily adhere.

Size of Grains.—The grains shall be well graded in size from the finest to the coarsest. For the greatest density not more than 8 per cent by weight, including the suspended matter, shall pass the No. 100 sieve, and not more than 60 per cent the No. 16 sieve. If maximum density is not essential and the mortar yields the required strength, these quantities may be increased to 12 per cent and 75 per cent, respectively.

Voids.—The voids in the dry sand, when well shaken, shall not exceed 33 per cent of the total volume of the sand.

Tensile Strength.—Mortar, in the proportions of 1:3 by weight, when tested at an age of 28 days shall develop a tensile strength at least equal to the strength of a similar mortar made of the same cement and standard Ottawa sand tested at the same age.

Specifications for No. 2 Sand.

General Requirements.—No. 2 sand shall meet the requirements for No. 1 sand in all respects except as follows:

Cleanliness.—The suspended matter shall not exceed 6 per cent by weight when tested in the same manner as described for No. 1 sand.

Size of Grains.—Not more than 15 per cent by weight, including the suspended matter, shall pass the No. 100 sieve, and not more than 80 per cent the No. 16 sieve.

Voids.—The voids shall not exceed 35 per cent of the total volume.

Tensile Strength.—The tensile strength shall equal at least 80 per cent of that of the standard Ottawa sand mortar when tested as described for No. 1 sand.

Specifications for No. 3 Sand.

No. 3 sand shall meet the requirements of No. 2 sand, except that the suspended matter may reach 8 per cent and the tensile strength be as low as 65 per cent of that of the standard Ottawa sand mortar.

Specifications for Plastering Sand.

Plastering sand shall meet the requirements for No. 3 sand in all respects except that for the finishing coat it shall be of the requisite fineness to give the desired finish.

Specifications for Grout Sand.

Grout sand shall meet the requirements of No. 3 sand except as follows:

It shall all pass a No. 16 sieve. The voids shall not exceed 38 per cent of the total volume. The tensile strength shall be at least 40 per cent of that of the standard Ottawa sand mortar.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—The cement market has advanced very little in the last month, except in certain localities, and the demand is light. Prices given of f. o. b. cars at points named, including cloth sacks, for which, in general, 40 cents per barrel (4 sacks) is refunded on return in good condition. Prices per barrel (including 4 cloth sacks) are as follows: Boston, \$1.72; New York, \$1.58; Chicago, \$1.55; Peoria, \$1.59; Pittsburgh, \$1.50; New Orleans, \$1.64 on dock; Memphis, \$1.82; Cleveland, \$1.58; Detroit, \$1.59; Indianapolis, \$1.63; Columbus, \$1.67; Toledo, \$1.54; Ft. Wayne, \$1.54; St. Louis, \$1.55; Milwaukee, \$1.60; Minneapolis and St. Paul, \$1.70; Montreal, \$1.75 to \$1.80; Toronto, \$1.95; Winnipeg, \$2.40 to \$2.50; Kansas City, \$1.63; Davenport, \$1.60; Omaha, \$1.68; Portland, Ore., \$2.10; Spokane, \$2.20; Seattle, \$1.90; Tacoma, \$2.00; Duluth, \$1.78.

Crushed Stone— $1\frac{1}{2}$ in. stone, prices per cubic yard, f. o. b. cars in carload lots, unless otherwise specified. Boston, 80c per ton at the quarry; New York, 90c to \$1.00, in full cargo lots at the docks; Chicago, \$1.15; Toronto, 70c to 75c per ton at quarries; Spokane, \$1.25; Seattle, \$1.25; Portland, Ore., \$1.10; Tacoma, \$1.25.

Gravel—Prices given are per cubic yard f. o. b. cars in carload lots unless otherwise noted. Boston, 75c; New York, 90c to \$1.00, in full cargo lots at docks; Chicago, \$1.15; Portland, Ore., \$1.10; Spokane, \$1.50; Seattle, 75c; Winnipeg, \$1.85; Tacoma, 60c.

Sand—Prices are per cubic yard, f. o. b. cars in carload lots unless otherwise indicated. New York, 50c, full cargo lots at docks; Chicago, \$1.15; Toronto, \$1.15; Portland, Ore., \$1.10; Spokane, \$1.25; Seattle, 75c; Winnipeg, \$1.75; Tacoma, 60c.

Reinforcing Bars—The demand is increasing but the prices in general are about the same as those given last month. Pittsburgh base quotations on mill shipments f. o. b. cars, are from \$1.15 per cwt., with the prevailing extras on bars under $\frac{3}{4}$ inch or base. The following are quotations on base bars per 100 lbs., for mill shipments from other points, f. o. b. cars: New York, \$1.31; Philadelphia, \$1.30; Chicago, \$1.33; Portland, Ore., \$1.25; Spokane, \$2.25; Seattle, \$2.25; Tacoma, \$1.90.

Shipments from stock are being made at the following prices per cwt. f. o. b. cars: Pittsburgh, \$1.65, New York, \$1.90; Cleveland, \$1.80; Cincinnati, \$1.80; Chicago, \$1.70; Montreal, \$2.15; Toronto, \$2.15; Winnipeg, \$2.50; Portland, Ore., \$2.10; Spokane, \$2.55; Tacoma, \$2.05; Seattle, \$2.25.

Metal Clips for Supporting Bars—\$7.25 to \$8.00 per 1,000, depending on size.

For the majority of the prices given we are indebted to the Universal Portland Cement Co., Sandusky Portland Cement Co., Concrete Steel Co., American Sand & Gravel Co., Chicago, and F. T. Crowe & Co., Seattle, Portland, Spokane and Tacoma.

Reinforcing bars for mill shipments are in general sold on a Pittsburgh basis; this is, at the Pittsburgh quotations plus the freight to the point in question, and with the following list of freight rates on finished material and the Pittsburgh quotation given, the price of bars at any of the points listed can be readily computed.

From Pittsburgh, carloads, per 100 pounds to:

Albany	16 cents	Birmingham	45 cents
New York	16 cents	Columbus	12 cents
Philadelphia	15 cents	Cincinnati	15 cents
Baltimore	14½ cents	Louisville	18 cents
Boston	18 cents	Chicago	18 cents
Buffalo	11 cents	Richmond	20 cents
Norfolk	20 cents	Denver	84½ cents
Cleveland	10 cents	St. Louis	22½ cents
		New Orleans	30 cents

New Books

REINFORCED CONCRETE CONSTRUCTION VOL. II.—Retaining Walls and Buildings.—Prepared in the Extension Division of the University of Wisconsin, by Geo. A. Hool. Cloth, 6x9 inches; 666 pages, 415 illustrations. Published by McGraw-Hill Book Co., Inc., New York. Price, \$5.00 net.

In our June, 1913, issue we reviewed Vol. I of Mr. Hool's proposed three volume treatise on reinforced concrete construction, explaining the purpose of the books and the features of the first volume. From the experience gained in reviewing the latter, the reviewer really felt a pleasure in the anticipation of reading Vol. II, and, space permitting, would dwell extensively on the features of this work which cannot be found elsewhere in the multitudinous books on the subject of reinforced concrete.

It seems that we are at last getting some books which are worthy of the engineer's attention as well as the student's. Let us hope for the good of all concerned that the third volume will be forthcoming ere long. This volume promises something on bridge design and construction and we venture to say that, judging from the popularity of its predecessors, it will be something beyond the ordinary.

This new volume possesses the same conciseness and clarity of expression found in Vol. I, which no doubt was largely responsible for its success. In writing Vol. II the author presupposes that the reader has a knowledge of the theory of reinforced concrete as found in Vol. I, and therefore often refers to the latter instead of explaining in detail certain steps.

The first part of the book is on retaining walls, and the second part on the design, construction and estimating of concrete building, taken up in sections in the order named.

In the first chapter on the stability of walls the author advocates the use of the equivalent fluid pressure theory as advanced by Turneure and Maurer, in place of the standard theoretical values, on the basis of the frequent inaccuracy of the latter. The chapter on design consists of illustrated examples of the design of various types of walls. The material on construction is too brief in view of its importance.

Chapter 4 treats of the various types of reinforced concrete floors, including flat slabs. This latter material is, in view of the best practice, entirely too conservative, from the standpoint of the engineer engaged in this class of construction. The various types of reinforcement in use are next described. The chapter on roofs contains some interesting examples of saw-tooth roof construction. Columns and foundations are next discussed, the material on the latter subject being especially good. The chapters on walls and partitions, and stairs are quite instructive on account of the number of illustrations given. A chapter on elevator shafts is valuable, but somewhat out of place in a book of this character. A short chapter on provision for expansion and contraction, with practical details, follows.

The theoretical portion of the book is found in chapters 13, 14 and 15, which treat of continuous beams, eccentric load on columns and wind stresses, but even here intricate mathematical analysis involving the calculus is conspicuous by its absence, which no doubt adds to the difficulty of presenting the subjects.

Chapters 16 and 17 give details of the design of a factory building and drawings and specifications of a building which was erected in Massachusetts.

Section 2, on construction, consists of seven chapters on materials, forms, bending and placing reinforcement, proportioning, mixing and placing concrete, finishing concrete surfaces, waterproofing and construction plant; the latter chapter, by A. W. Ransome, is an excellent one for the plant designer. The chapter on forms is more complete than is generally the case in text books.

Section 3, on estimating, is by Leslie H. Allen, of the Abertaw Construction Company, Boston, whose method of estimating the cost of concrete building is given in detail. This section is a valuable addition to the book. An appendix gives the latest recommendations of the joint committee for plain and reinforced concrete.

We can unhesitatingly say that this is the best general volume on reinforced concrete which can be obtained today, and we believe that every engineer will find it valuable as a reference work. Mr. Hool has rendered another distinct service to the profession.



The Signal Department

THE CHARACTERISTICS OF A GRAVITY CELL.

(Continued from the March Issue.)

By B. W. Meisel

The data with a few characteristic curves, obtained from an experiment on a gravity cell working under different temperatures, was published in the March issue. Inasmuch as curves shown in figures 6, 7, 8, 9 and 10 herewith were developed from the results of the same experiment, it will be necessary to refer back to that issue.

Figure 6 shows the voltage temperature and current temperature curves for the gravity cell connected across a 4 ohm Hall type track relay. The data, obtained in the experiment from which the curves were plotted, can be found in columns E_o and I' of the March issue. Figure 7 shows voltage temperature curves with constant current as follows: Curve "A" .15 amps., curve "B" .2 amps., curve "C" .25 amps. The voltage values were taken from column V_c , corresponding to the value of the current in column I' . (March issue.)

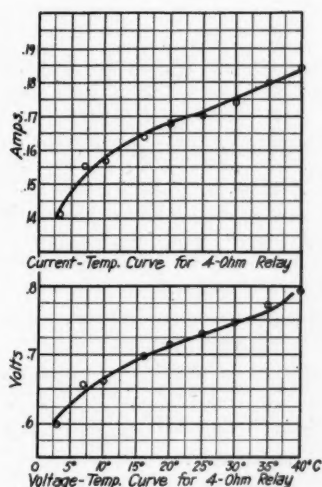


Fig. 6.

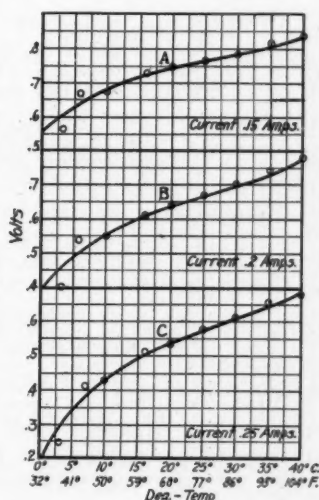


Fig. 7.

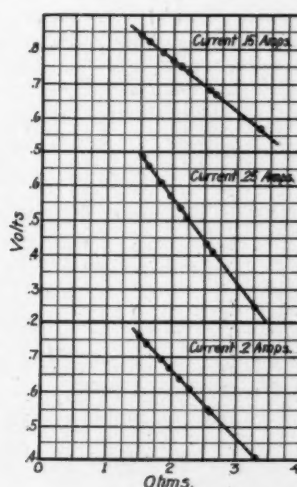


Fig. 8.

Figure 8 shows curves plotted from the same data, using V_c as ordinates, and the corresponding values of internal resistance

$$R_i = \frac{V_o - V_c}{I}$$

R_i , as the curves show, is constant for different values of current.

The curves shown in figures 9 and 10 were plotted from the calculated data herewith. The object was to determine the voltage "E" and the current "I" delivered by a cell or cells, working under different temperatures, to a circuit of known resistance R_x . The resistance used was 4.5 ohms, which closely approximates that of a track circuit. From figures 3, 4 and 5, shown in the March issue, the values "E_o" the open circuit voltage of one cell, of 2 cells in series or of 2 cells in parallel, and also the internal resistance of the same combinations of cells shown in curves A, B and C, can be had for any value of temperature. Then by means of the formulae 1, 2 and 3 below, I_1 for one cell, I_2 for two cells in parallel, and I_3 for two cells in series, can be calculated,

$$(1) I_1 = \frac{E_o}{R_i + R_x} \quad (2) I_2 = \frac{E_o}{\frac{R_i}{2} + R_x} \quad (3) I_3 = \frac{2 E_o}{2 R_i + R_x}$$

The drop across the resistance may be determined from the formulae 4, 5 and 6:

$$(4) E_1 = E_o - R_i I_1 \quad (5) E_2 = E_o - \frac{R_i}{2} I_2 \quad (6) E_3 = 2(E_o - R_i I_3)$$

Figure 9 shows the voltage curves, (A) for 1 cell, (B) for 2 cells in parallel and (C) for 2 cells in series.

Figure 10 shows the current curves, (A) for 1 cell, (B) for 2 cells in parallel and (C) for 2 cells in series.

The results of these calculated curves check very closely with those plotted directly from the experimental data shown in figure 6.

Plate 8 shows the voltage curves (A) one cell, (B) two cells in parallel and (C) two cells in series.

Plate 9 shows the current curves (A) one cell, (B) two cells in parallel and (C) two cells in series.

The results were checked up with the voltage, current, temperature curves, and were found to agree closely with them.

Calculated Data from Figures 3, 4 and 5 for Figures 9 and 10.

T° C	I_1	E_1	I_2	E_2	I_3	E_3
5°	.144	.6494	.179	.8064	.207	.932
10°	.153	.688	.1859	.8364	.226	1.0156
15°	.159	.7146	.19	.856	.239	1.0756
20°	.163	.732	.193	.8682	.248	1.1192
25°	.166	.744	.195	.8768	.2545	1.1445
30°	.169	.76	.1973	.8874	.262	1.1836
35°	.1725	.776	.20	.896	.2712	1.221
40°	.1765	.7842	.2022	.91	.2812	1.266
45°	.1805	.8133	.205	.9225	.292	1.3144
50°	.185	.8292	.2076	.9331	.302	1.359

Power and Efficiency of Gravity Cell.

Experiments were performed in order to determine the change of power output and power generated and the efficiency of a gravity cell at constant temperature. From the data collected curves were plotted. In one experiment a constant temperature of 37° centigrade was maintained, and the external resistance (R_x) varied. Readings were taken of V_o , the cell voltage; V_c , the drop across R_x ; I , the current delivered. From these readings R_x , R_i , the internal resistance; P_i , the power generated; P , the power output; and E , the efficiency, were calculated. Using values

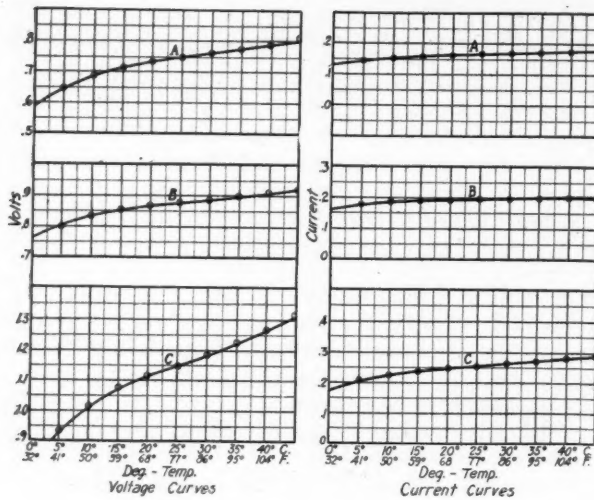


Fig. 9.

of R_x as abscissas and P_i , P and E as ordinates, their respective curves were drawn. Using 21°C. as another value of temperature, the experiment was repeated and curves plotted.

Fig. 11 shows the curves for 37°C. and Fig. 12 the curves for 21°C. Comparing the two sets of curves, it is seen that P_i , P and E are greater for a given external resistance at 37°C. than at 21°C.

T	EXPERIMENT.		I	R_x	CALCULATED.			
	V. O.	V. C.			R_i	P_i	P_o	E
37°C.	1.02	.94	.05	18.8	1.63	.0511	.047	.92
or	1.02	.857	.1	8.56	1.63	.102	.0856	.848
98.6°F.	1.02	.77	.15	5.15	1.63	.153	.11625	.76
98.6°F.	1.02	.686	.2	3.45	1.63	.203	.1384	.682
98.6°F.	1.02	.6	.25	2.44	1.63	.254	.1525	.60
98.6°F.	1.02	.523	.3	1.76	1.63	.305	.157	.515
98.6°F.	1.02	.511	.312	1.63	1.63	.317	.1501	.505
98.6°F.	1.02	.44	.35	1.27	1.63	.355	.1538	.438
98.6°F.	1.02	.36	.4	.912	1.63	.407	.144	.354
98.6°F.	1.02	.28	.45	.628	1.63	.457	.126	.276
98.6°F.	1.02	.2	.5	.42	1.63	.5125	.1	.195
98.6°F.	1.02	.12	.55	.218	1.63	.575	.066	.0144
98.6°F.	1.02	.04	.6	.0668	1.63	.611	.024	.00393
21°C.	1.020	.91	.05	18.22	2.08	.051	.0455	.91
or	1.020	.81	.1	8.1	2.08	.102	.081	.794
71.8°F.	1.020	.7	.15	4.7	2.08	.153	.105	.686
71.8°F.	1.020	.6	.2	3	2.08	.203	.12	.592
71.8°F.	1.020	.511	.245	2.08	2.08	.2496	.1252	.502
71.8°F.	1.020	.5	.25	2.00	2.08	.255	.125	.49
71.8°F.	1.020	.395	.3	1.32	2.08	.306	.1185	.387
71.8°F.	1.020	.29	.35	.962	2.08	.360	.1015	.282
71.8°F.	1.020	.19	.4	.475	2.08	.408	.076	.186
71.8°F.	1.020	.087	.45	.196	2.08	.4508	.039	.0846
71.8°F.	1.020	.63	.475	.074	2.08	.486	.0143	.0295

T = temperature. V. O. = volts open circuit. V. C. = volts closed circuit.
 R_x = external resistance.

Maximum Power Output at Different Temperatures.

Maximum power output (P) occurs when the external resistance (R_x) equals (R_i) the internal resistance. Power output $P = EI$, where E and I are the values of the E.M.F. and current, taken from figures 3, 4 and 5, March issue. The E.M.F. being $\frac{1}{2} E_o$ the open circuit voltage and I being the abscissas of the curves at the point $\frac{1}{2} E_o$. E for the maximum output of any given arrangement of cells is constant, while I varies with the temperature. These values were taken from the different curves

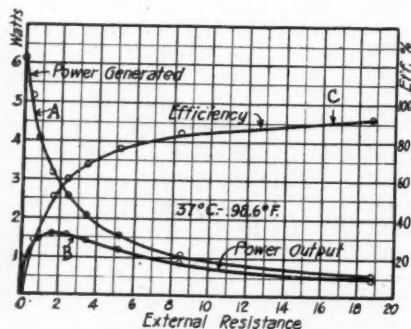


Fig. 11.

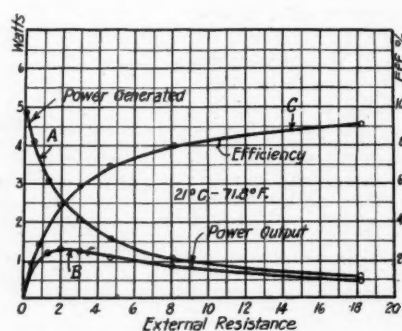


Fig. 12.

of figures 3, 4 and 5 and the maximum output calculated. From this data curves of output and temperature were plotted. These are shown in Fig. 13.

These power curves are seen to follow somewhat the characteristic of the internal resistance curves, that is: below 20°C. the curves for power output drop rapidly, while the internal resistance curve rises rapidly. Above 20°C. both curves follow straight lines, the power curves rising and the resistance curves dropping.

The power curves differ, in that, for one cell the curve is more straight than for two cells in parallel or series, while the curves for parallel and series grouping follow practically the same points. This should be so since the voltage of two cells in parallel is the same as that of one cell and the current is twice as great as that of one cell. With two cells in series the voltage is twice as great as for one cell and the current the same as for one cell. Letting E and I be the voltage and current of one cell, the power output of two cells in parallel is $E \times 2I$, while the output of two cells in series is $2E \times I$.

Therefore the maximum power outputs of the two arrangements should be equal for corresponding temperatures.

Data for Maximum Power Output Taken from Figures 3, 4 and 5.

T°C	one cell			two cells in parallel		two cells in series.		
	E	I	B	I	P	E	I	P
0°	.533	.149	.0795	.295	.1571	1.066	.148	.1577
5°	.533	.182	.0971	.362	.193	1.066	.185	.1972
10°	.533	.215	.1145	.428	.228	1.066	.215	.229
15°	.533	.241	.1285	.478	.2545	1.066	.242	.2578
20°	.533	.261	.1391	.515	.275	1.066	.261	.2782
25°	.533	.277	.1475	.554	.295	1.066	.277	.295
30°	.533	.293	.1562	.580	.309	1.066	.293	.3122
35°	.533	.309	.1645	.606	.323	1.066	.309	.3292
40°	.533	.326	.1728	.632	.337	1.066	.326	.3462

THE EYMON CONTINUOUS CROSSING CO., has been organized at Marion, Ohio, with a capital stock of \$150,000.

THE INTERNATIONAL CAR CO. plant at Forty-second and Loomis streets, Chicago, was damaged by fire on June 2 to the extent of \$100,000. About 100 cars in the plant were badly damaged.

THE H. W. JOHNS-MANVILLE COMPANY has moved its Duluth, Minn., office to larger quarters at 327 West First street.

THE WATROUS COMPANY, CHICAGO, has moved its Chicago office from the Fisher building to 1101 Lytton building.

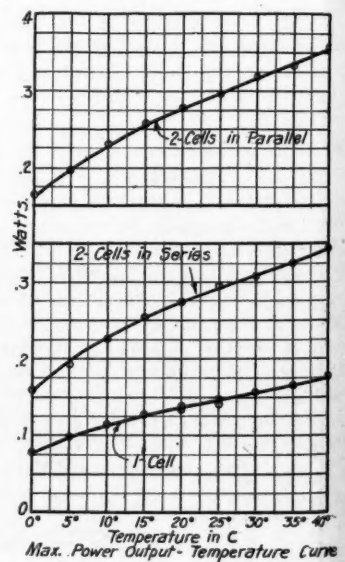
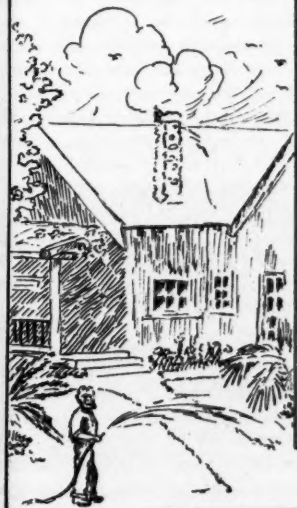


Fig. 13.

The Engineer's Distress

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A. S. Gunn Editor



The Baggage Man Resigns

The ould S.P. I have loved thee
But its toime fer us to part,
Tru smoiles an' tears, fer thirty years
Oive served thee wid all me heart,
All tru loife, in this world of stroife,
Oive always been true to me trust,
But loike a ghost, came the Parcel Post,
And upon me this burthen was thrust.

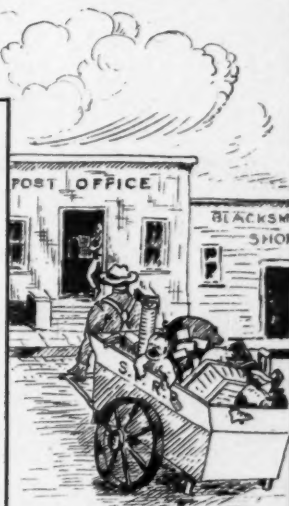
In the years gone by, widout tear nor sigh,
Twas whin I was young and hearty,
I would tamp a tie, in the wink of an eye,
An the siction fer Dinnis McCarly,
Now Oi'm the baggage man, an' I do all I can,
Fer this is the job I love the most.
But alas and alack, they're breaking me back,
Wid this blasted Parcel Post.

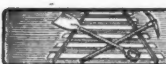
From daypo to town, up hill an' down,
I trundle me truck widout fail,
Aftther each train, tru sunshine an' rain,
To the post-office I carry the mail.
No wurd can I say 'bout increase in me pay,
Shure if I did I wud git a hot roast,
Fer ould Uncle Sam, he dont give a d-n,
But compels me to trundle the post.

The Wells-Fargo Expriss works wan horse liss,
Fer their business has fell off, of course,
Tru sunshine an' hail, I must carry the mail,
An' do all the work av' thot horse,
Now ould Uncle Sam, wid face serene an' calm,
Of great savin in expinse he do boast,
But in me toime av' need, to satisfy his greed,
Widout pay I must trundle the Post.

'Tis breaking me heart, this pushin the cart
Filled up wid' all sorts of plunder,
Theres dogs and cats, an' cryin brats
An' pigs in the mail by thunder.
Fer ladies theres hats, fer dudes theres spat,
An' lots av' things the kiddies love most,
But day aftther day, widout thought av' pay,
I must carry the Parcel Post.

While shmokin me cob, I think av' me job
An' it shure has got me nanny,
So this job I will quit, an' a cart I will git,
An' on the shirate Oi'll peddle the benannie.
A widdy Oi'll marry, an' wid her Oi'll tarry.
In a nate little house on this coast,
Wid a tear in me eye, Oi'm sayin' goodbye,
An' to h—l wid the Parcel Post.





The Maintenance of Way Department

RAIL RAVELINGS.

Dear Son:

I will give you a chapter in my experience of laying track under difficulties, which you may profit by some time. I was sent out to superintend the laying of this track just as a "wet spell set in," as our farmer friends say.

The grade was practically completed before the rain came, but the ditches in the cuts had not been cleaned out, consequently it made bad work of the roadbed. There was only about six miles of main line to lay and about three miles of yard tracks.

Track laying on main track began late in November. Under good or ordinary conditions of roadbed and weather, this piece of main track, which was laid by a contractor using a track-laying machine, would be put down at the rate of a mile a day with a small force of men, and the ballasting would have been done in about ten days. As it was, it took over a month to accomplish the work.

The grade was built through a rough country, having a continuous cut at once place over two miles long ranging in depth from four to 25 ft. in depth.

At one end of this cut there was a fill to meet a trestle approach to a bridge. This approach was 50 ft. high, and the embankment was of corresponding height and all freshly made. In order to waste the surplus dirt from the cut this fill was widened out until there was ample room for three tracks instead of one. The surface being so broad caused the water, when the heavy rains came, to soak into the ground instead of running off as it would on a narrow embankment. This water in the fill caused heavy and uneven settlement, adding greatly to our troubles.

The first mile of the grade was solid enough so that comparatively little trouble was experienced in laying track. Then we entered the long cut, the bottom of which was soft clay, the kind found where soft coal is mined, as this was a coal road. Anyone familiar with this kind of clay will tell you it is as soft as the softest. Instead of going straight down, track slides badly in this material, thus going out of line as well as out of surface, and the line is hard to "doctor" in the mud.

A 10-wheel connected locomotive was used on the track-laying train. As soon as the soft bed in the cut was encountered our trouble began in earnest, as the track would go out of sight in the mud as soon as the locomotive was run on it, and keep going as long as any part of the train remained upon it.

To make it possible to get over with the train we had to resort to "weaving in" ties; that is, as soon as the 18 ties for one rail length of track was laid in place ahead of the train, ties were placed between them from each side, the end of the interlacing ties coming nearly to the center of the track, thus making practically a solid floor of ties under each rail. This necessitated laying enough ties for three tracks.

By exercising care the train could be pushed forward over this arrangement to lay the track and then back slowly off. A half mile of track would be laid, and then a train of gravel would be pushed out on the soft track as far as possible and plowed off with a Lidgerwood. Of course, the extra ties were buried by this process, but it was unavoidable. As soon as the train was unloaded and pulled off the track, from four to six jacks would be placed on one side and the track raised about one foot. The gravel was then shoveled off the extra ties as best it could be done and thrown under. Enough would be cleaned off in this way to allow the interlacing ties to be pulled out, after which the tamping was done and the jacks moved to the other side of the track and the process repeated.

As soon as one train of gravel was put under the track, another train would be shoved out and unloaded and the gravel put under as before. Enough gravel would be used to "put the track up" as far as laid. When the track was made safe for a locomotive, another short stretch would be laid and graveled. This method was kept up until the two miles in the cut were laid.

When we got on the big fill we had to proceed with great cau-

tion, as the roadbed would settle on one side a good deal more than the other, and at times it seemed the locomotive would tip completely over before it would get out of the holes. When we finished laying a train of steel (and we took short ones), it would be necessary to take men and jacks and go back and weave in ties and block up the bad spots in the track before the train could be taken back over it. Ties for this purpose were thrown off as the train passed over when laying track. All ties used for interlacing had to be loaded up and taken back to the material yard after the gravel was put under.

After crossing the high bridge mentioned above the big fill continued for a distance, and soft spots or sink-holes developed all the way across, causing untold delay and making a very expensive piece of track laying for the railroad company, inasmuch as they had to pay the contractor "force account" for all extra work of handling ties and temporary blocking up the track; 90 lb. steel and treated red oak ties were used, a fact which helped us out greatly, as light rail and soft ties would have been much more difficult to handle under the conditions we encountered.

If you are placed where you have conditions like the above in construction work, you will find that the chief requisite in the man in charge is "sand." Confidence in himself is necessary, as is also the faculty of making his men have confidence in his judgment. Another requisite is the knowledge of just how much chance can be taken with a locomotive on new soft track.

DAD.

NATIONAL BUREAU OF LABOR EXCHANGE.

Tentative proposals for national legislation to wipe out chronically chaotic conditions in the country's labor market and thus strike a blow at the annually recurring evils of unemployment were made recently by the United States Commission on Industrial Relations, with requests for criticism and suggestions.

It is proposed to establish a National Bureau of Labor Exchange in connection with the Department of Labor, with a central office in Washington and branch offices in other cities, and with a clearing house for each of several districts into which the country would be divided. The bureau would have power to establish and conduct free public employment offices.

The National Bureau would have jurisdiction over all private employment offices doing an interstate business or accepting workmen for shipment to other states. State, municipal and private employment offices would be urged to cooperate with the National Bureau and to adopt uniform methods and regulations.

The bureau's most important service would be to gather and distribute accurate information regarding the labor market in various localities. This information would be published in the form of bulletins, to be issued at frequent intervals and to be circulated in such a way that it would be available to every person in search of work and every employer seeking workmen.

An advisory council is suggested for the National Bureau and for each district, to consist of an equal representation from employes and employers, to aid in determining policies and to see that the bureau remains impartial in all disputes.

Daily reports of business would be required of sub-offices to the district offices, and weekly reports would be required of the district offices. Other employment agencies would be urged to cooperate and send in similar reports. Policies and measures have already been drafted in such form that they may be presented to congress for the enactment of a law.

MEASURING TONNAGE OF PANAMA CANAL SHIPS.

Warships passing through the Panama Canal are to be taxed on their tonnage displacement as determined by displacement scale and curves. All other ships are to be assessed on net tonnage. The three ways of expressing a ship's tonnage are: (1) displacement tonnage; (2) gross tonnage; (3) net tonnage.

Laying Steel Without Spacing Joint Ties

By F. A. Preston.*

In their efforts to reduce operating and maintenance expenses to a minimum the railroads of the United States have brought about many changes in their old methods which have resulted in economies heretofore hardly thought possible.

Inability to get good track laborers and often the impossibility of getting laborers at all to complete maintenance programs at the proper time, has resulted in the closest scrutiny into maintenance conditions, and any method or device which dispenses with labor and therefore effects economies has been sought with greatest zeal.

The result has been the adoption of more efficient methods of handling and boarding track laborers, the use of dump cars for the quick and economical distribution of ballast, the proper distribution of steel and the consideration of machines for laying rail and other practices too numerous to be detailed here.

joint, providing of course that the joint itself is substantially as strong as the rail. Where plain angle bars are used they should be reinforced, and railroads that use angle bars and do not space ties, have special designs of bars with increased weight and section, and in some cases the reinforced bars are heat-treated to further improve the material in the bars.

Some large railroads lay their joints suspended as common practice, while others support their joints. And it is maintained by roads that do not space their ties, that, inasmuch as their joints, when laid without regard to the position of the tie under the joint, must necessarily be either suspended or supported, they are conforming to standard practice by placing their joints in either position as the case may be.

In the old method, ties were spaced for the one other reason that the joints which were spike-slotted could be spiked to the ties and therefore prevent rail creeping. No doubt this was good practice when creeping tendencies were so light that



Fig. 1—Disturbance of Joint Foundation Due to Rail Creeping.

Recently the question of laying steel without spacing joint ties has attracted a great deal of attention, resulting in several large systems doing away with tie spacing at the joints altogether. Some roads have done so after the successful outcome of their own experiments and others have profited by their experience.

It is a well-recognized fact that the joint is the weakest part of the track structure, and for this reason it should have a solid and permanent foundation. The common method of shifting ties to permit spiking the joint, either suspended or supported, disturbed the old foundation under the joint ties and in place of affording a better support, in reality made a weak spot requiring considerable tamping and time before the old foundation was regained.

Disregarding the disturbance to the foundation, the position of the tie under the joint should have no effect on the

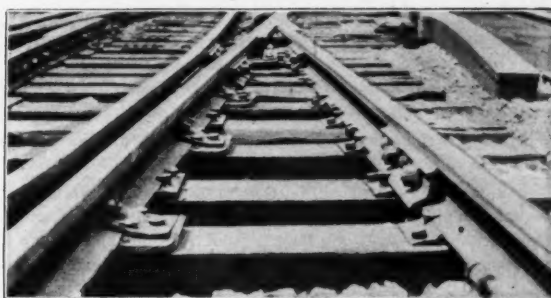


Fig. 3—Reinforced Angle Bar for Use Where Ties are Not Spaced or Slot Spiked at Joints.

this method eliminated rail movement altogether, but the disproportionate relation of the wheel loading to the track structure has so increased creeping that this method is not only inadequate to overcome creeping, but it is positively a detriment, as it pulls the ties from their first position, making necessary the application of anti-creepers opposite the joints on broken jointed track on the free end of the joint ties to keep them straight. Inasmuch as joint ties so spaced are always insecure, because of the excessive vibration occurring at the joint, they do not offer the resistance to creeping that would any other tie in the panel, consequently the full efficiency of the anti-creepers applied at the joints is not received.

The joint has enough work to perform without resisting rail creeping, and under no conditions should it be made to act as an anti-creeper. Where rail is laid without spacing ties, the joint should never be spiked to the ties, regardless of

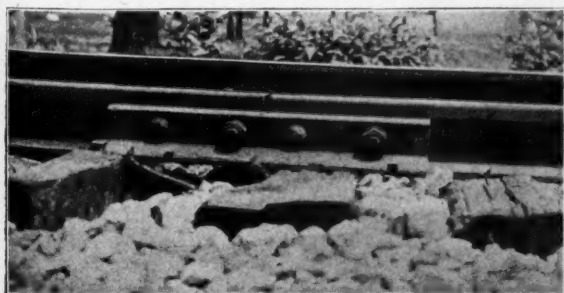


Fig. 2—Damage to Slot Spiked Joint, Due to Creeping. Ties in Rock Ballast.



Fig. 4—Slot Spikes Which Failed to Prevent Creeping. Ties Shoved Off of Beds.

* General Sales Agent, P. & M. Co.

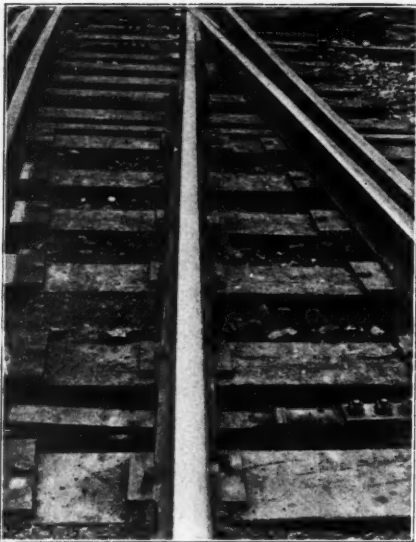


Fig. 5—Rail Anchors to Prevent Creeping at Interlocking Plants, Unslotted Joints.

their relative positions, and the spike slots should be omitted from the joint altogether.

Railroads that have adopted this method as standard practice are no longer having joints punched for spikes.

When track is laid without slot spiking the joints, anti-creepers should be applied in sufficient quantities when the rail is laid to prevent all longitudinal rail movement and to hold expansion. They should be installed at intermediate ties in the panel, away from the joint, always placing the anti-creepers in pairs, one at each end of the same tie. On single track, anti-creepers should be applied to prevent rail moving in either direction, and should be placed so that only two anti-creepers are against the same tie. Where creepage occurs in both directions on single track, the placing of four anti-creepers against the same tie, two to prevent creeping in one direction and two in the other direction, should be avoided as the effectiveness of the anti-creepers so placed is largely lost. Where gravel or lighter ballast is used, of course, more anti-creepers should be applied than where stone or heavy ballast is used.

The use of anti-creepers in connection with laying steel without spacing ties is most important, and their installation immediately after the steel is laid should not be overlooked, as otherwise the rail will be free to run, with disastrous results.

The economies effected by laying steel by this new method are most obvious. Fully 25% of the cost of laying steel is taken up in the spacing of ties and resurfacing; the first of these costs is practically eliminated and the second is greatly



Fig. 7—Rail Anchors Opposite a Slotted Joint.



Fig. 6—Angle Bar Without Spike Slots.

reduced when steel is laid without regard to joint tie spacing, and in addition life is added to the tie, rail and its fastenings. The cost of the reinforced angle bar and additional anti-creepers is more than offset by this saving, and at the same time the riding surface and appearance of the track are much improved.

One railroad that has had extensive experience with this practice and has kept careful record of its maintenance expenses has recently made the statement that, including the cost of reinforced heat-treated angle bars and necessary anti-



Fig. 8—Anti-Creepers Applied to Prevent Creeping in Either Direction. Opposing Anchors Would Be More Efficient if Applied to Different Ties.

creepers, they have found the saving to be in excess of 35% of the cost of laying steel where the old method of tie spacing at the joint was used.

Fully as important as this saving from not spacing of ties, is the fact that steel may be laid in the winter time, permitting the regular track forces to be kept practically intact during the entire year. This avoids the necessity of employing a large number of unskilled laborers during the warmer months, at a time when the demand for track laborers far exceeds the supply, and it also obviates the necessity of letting extra gang men go, together with some of the regular section men, during the winter months.



Fig. 9—Anti-Creepers Applied to Protect Fibre Insulation at Insulated Joint—No Slot Spikes at Joints.

Not only is the difficulty of obtaining any labor, regardless of the quality, eliminated, but a much better class can be procured at lower wages during the winter months, and here again the saving is quite obvious.

The one thing that has made the railroads hesitate to adopt this practice more generally has been the impossibility of providing suitable means of preventing rails from creeping. But the advent of self-maintaining, efficient anti-creepers has eliminated this objection and it is predicted that it is but a matter of time until the spacing of joint ties, when the rail is relaid, will become obsolete. And it is quite certain that those railroads which have already adopted this method are heartily endorsing it as a most economical practice.

RAIL CREEPING.—NO. 8.

W. E. Schott, Foreman.

Rail creeping and its possible prevention being a subject of universal interest, I would like to mention a case of the worst kind, which came under my observation during 1906 and 1907, while employed as foreman at Toomey, La., on the L. W. R. R.

The last four miles on the west end of my section led through the Sabine swamp. For a mile and a half the track ran over a 20-foot fill; the next $2\frac{1}{4}$ miles consisted of a wooden trestle and the last $\frac{1}{4}$ mile was fill up to the Sabine river, where the track ran onto a draw bridge. This whole piece of track was level and straight, with the exception of a 3-degree curve located partly on west end of trestle and partly on adjoining fill. The rail, having recently replaced 62-pound steel, was 75-pound steel, 30 feet long, tied with 16 cypress ties to the rail and tie-plated with the old three-ribbed tie-plate.

Traffic consisted of from six to eight passenger and from fourteen to twenty freight trains daily. Engines used were of the Atlantic type.

The trestle was the then adopted standard of the S. P. R. R. Ties and rails, 22 ties to a 30-foot rail, rested on six wooden stringers, 7 by 16 inches by 30 feet, three under each rail. The stringers were supported every 15 feet by a pile bent, four piles to each bent, capped with a 12 by 12-inch by 12-foot timber. The ties over each bent were anchored to same with a 42 by $\frac{1}{2}$ -inch bolt. Track spikes were not driven in slots of angle bars, over the trestle.

On taking charge of this section, the roadmaster advised me of the creeping tendencies of that part of my section and also of the necessity of going to the end of this piece of track at least twice a week to drive rails back or saw off a piece with a hack saw to keep rails from jamming the drawbridge. For the first eight weeks I cut off an average of 2 inches weekly, and upon reporting this fact we decided to cut the track and to put points about one-fourth mile east of draw, very near to the east end of the short fill, between trestle and draw. This procedure was a success as far as the joints at the bridge were concerned, but another and more serious trouble arose. So far, the creeping of the steel on the trestle had been checked to some extent by the short piece of track on the fill just east of the draw bridge. It was a dirt fill, surrounded by swamp, the track slightly ballasted and equipped with anti-rail creepers, six to a rail. After placing points in our track, the creeping steel had nothing to hold it back and barely a week after placing those points, I was called out one night by a train crew to renew a broken rail or what they thought to be a broken rail. I went to the place described and found two joints, open 6 and 8 inches, respectively. The track bolts, unable to bear the strain any longer, had snapped off, and the joints had opened. I closed the joints by driving about 20 rails back. From that night on, it was a frequent occurrence to find open joints on account of bolts or angle bars breaking, and on one occasion I found a joint open 22 inches. This gap being too wide to be closed by driving back rails, I removed one 30-foot rail, replacing same with a 15-foot and a 16-foot ten-inch piece, and being forced to do something to remove this serious obstacle to traffic, I started next day to spike all joints on trestle in angle bar slots and also to bolt or spike all joint ties to bridge stringers. For about four weeks

after doing this no joint breakages occurred and I was more or less sure I had found a check at last.

One day a Mexican laborer dropped a lining bar through the bridge very near the west end, and while climbing down on a bent to recover it I discovered the bent to be a little over six inches out of plumb. Making a thorough inspection of every bent on the trestle, I found the first one eight inches and the succeeding fourteen bents out of plumb in proportion, the fifteenth being again nearly plumb. The whole end of the trestle had been pushed in a westerly direction by the creeping steel anchored to the trestle. After considering the proposition a few days, the management decided to fill in the whole trestle, no other course being left open. We opened a dirt pit, and a contractor started to make a fill from trestle through the Sabine swamp. After this fill had settled sufficiently, the track was ballasted with crushed rock, the steel equipped with eight anti-rail creepers to each rail, and the former trouble caused by creeping steel has been reduced to a minimum.

UNIQUE METHOD OF REMOVING BLUFFS ABOVE TRACKS

Andrew Palm, Roadmaster.

Some years ago I was troubled with a piece of track which was always settling; it was located in a through cut about 12 ft. in depth. A stratum of blue clay about 250 ft. wide crossed diagonally under the track; the depth of the stratum was not known. A stream of water flowed through this cut the year round with the exception of about six weeks in mid-summer. During clear weather we were compelled to resurface this portion of track at least once a week; in stormy weather we had to resurface it every day, and oftentimes at night by the light of lanterns, to keep trains moving. This condition existed for nearly twenty years, and during that time numerous methods were tried to hold this portion of track to permanent surface; I had the track dug to a depth of 4 ft, then filled the excavation with boulders with 6 in. of gravel under the ties on top of the boulders; in a few months the boulders began to come to the surface of the ground in the ditches at the sides of the cut, and had to be removed so as not to obstruct the drainage. In a short time all of the rocks were forced out from under the track.

The track was dug out again and a bed of ties was placed under the track, parallel to the roadbed; upon this tie-bed two feet of crushed stone was placed, but the clay soon oozed through and forced the ties and rock ballast to the surface in the side ditches. No matter what method was tried, the track always sank; as the clay strata crossed the roadbed diagonally the track would settle as much as 6 in. in a day on one side, while the other side of the track would remain to surface. This condition existed for a distance of two rail lengths at both ends of the sink. It can readily be seen that during storm periods this stretch of track was very treacherous and required constant watching and repairs.

Many of our bridges were built of creosoted timbers, and some of the creosoted stringers were removed on account of cracking, and we procured the latter and cut them into 22 ft. lengths. Then we excavated to the depth of $3\frac{1}{2}$ ft. under the ties for the entire width of the cut, 24 ft., cribbing with ties, plank and wedges to allow the passage of trains. When we were ready to lay in a section (a half rail length), we would remove the cribbing, rails, and ties. We first scattered straw to the depth of about 8 in., upon which we placed the stringers flat and tight together, and upon this floor for the entire width of the cut we placed a bed of screened crushed stone, repeating this process for the entire length of the sink, and the following year this portion of track required very little attention.

Many may wonder why we placed straw beneath the stringers; the clay when dry was of a fine powdery nature and at the depth the stringers were laid the clay was wet, or, as one of the men employed on that section termed it, a "loblolly," and we feared that the clay would have a tendency to cup

the stringers where the edges came together. We surmised that the straw would form a mat through which the clay would not ooze.

I recall a bluff slide which was very troublesome, existing from construction days to about 28 years later, each year tying up traffic during storm periods, delaying traffic from several hours to three days at a time. The various roadmasters who had been in charge of this district, during the existence of this slide, were severely criticized by the management for allowing it to exist; and although the roadmasters would submit estimates of the amount of funds necessary to render this point safe, no money would be appropriated for this purpose. For the safety of trains an order was in existence requiring all trains to slow down and look out for signals from the watchmen, who for years were constantly kept at this point.

A change of management occurred and inquiries were made as to the cause of the slide and what preventative measures were advisable. Before construction days this point was a sheer precipice of over four hundred feet to where roadbed was cut into the side of the mountain. The formation was of porphyry and slate rock in thin layers.

During construction at this point a tunnel was driven at right angles with the roadbed for a distance of forty-eight feet, then lateral tunnels, each eighteen feet in length were cut, one to the right and the other to the left of the extreme end of the main tunnel. The lateral tunnels were filled with explosives and the main tunnel was filled with earth and rocks. It was estimated that 35,000 cu. yds. of rock was thrown out by the one shot, which loosened and crumbled the whole mountain for several hundred feet along the river, and how far into the mountain it is not known.

A foreman who was in charge of some of the grading states that the chief of the construction forces was asked what slope should be given the rock cuts; his reply was, "Build the roadbed, the Almighty will make slopes." A trip through that canyon will convince anyone that it is very evident that the chief's confidence in the Almighty was not misplaced. For many long, weary days and nights during the winter, or storm periods, the track forces are clearing the track of scenery which the Almighty is dislocating while fulfilling the prediction made by the chief many years ago.

Returning to the slide in question: when the change of management occurred this slide was investigated and ordered sloped so as to eliminate all danger to trains; as this slide was of great height the question was how to remove the mass without hindering traffic. At first it was decided to use a steam shovel and haul the excavated material away by the use of work trains. A close inspection, however, showed that the mass of rock was too treacherous to use the shovel, as it was evident that by working in from the roadbed the whole mountain-side would move down and bury both the shovel and track and in all probability traffic would be blocked for several weeks. So it was finally decided to work from the top instead of from the bottom; at this point there was a sheer drop from the roadbed into the river of one hundred and fifty feet, and it was decided that all the debris could be disposed of at this place and work trains would not be needed.

A shed with a steep, sloping roof made of defective bridge timbers was constructed over the tracks. When the shed was completed an extra gang was put to work on top of the slide and the mass was moved down over the shed into the river, consuming about three months of this gangs' time. The slope was completed without delay to trains or an accident of any kind and no further trouble was experienced at this point.

At another point there was a very high side cut, the formation of which was of volcanic ash which was constantly moving and rolling down upon the track. Two watchmen, a night man and a day man, were kept at this point and there was a permanent slow order. The watchmen were engaged the greater portion their time in clearing the track of the small rock which was constantly drifting down upon the track, amount-

ing to a yard or more during twenty-four hours; no serious delay to trains ever occurred at this point.

After clearing the slide heretofore described it was decided to remove the shed to this point and use it as a permanent structure to protect this track. This was done, thereby eliminating the watchmen and recalling the slow order for the first time in many years.

LABOR PROBLEM AT B. & O. TIE TREATING PLANT, GREEN SPRING, W. VA.

The Green Spring tie-treating plant was described in the June, 1913, issue of *Railway Engineering*. Mr. C. C. Schnatterbeck, in the B. & O. Employees' Magazine, gives, in addition to a description of the plant, the following information on the labor problem:

The labor problem is perhaps the most vexatious that had to be adjusted in order to put the timber-treating plant on a commercial footing. Green Spring, although only fourteen miles from Cumberland, is in a valley but little populated, and is not an incorporated town. There are few accommodations, little opportunity for mental relaxation, and the natural, romantic beauty is virtually the only attraction. There is good hunting in the Allegheny Mountains, plenty of fish in the Potomac, and beautiful wild flowers in the surrounding fields and woods during the summer time, but of recreation such as men are accustomed to in the larger towns there is none. The timber-treating plant is practically the only center of remunerative occupation outside of the railroad itself. At the plant are employed Austrians, Hungarians, Poles, Russians, Italians, Swedes, French, Germans, Americans, men of varied color and nativity. The common labor is mostly foreign; the skilled labor, American.

The pieceworkers on the Back Track Gang are paid 1½ cents per tie, and they have averaged from \$1.75 to \$4 per ten hour day. Those on the Truck Gang receive from 45 to 50 cents per tram, and are earning at the rate of \$1.75 to \$2.65 per ten hour day. The Platform Gang, also pieceworkers, receive 45 cents per tram for machine loading and 50 cents per tram for hand loading, and are earning an average of \$1.85 to \$3.25 per ten hour day.

The plant has a good commissary; board is cheap and satisfactory. Box car cottages have been built on the original lines and are rented to employees. Commodious quarters for the superintendent and clerks have also been provided.

SPECIFICATIONS FOR SURFACE FINISH ON APPROACHES TO THE NORTH SIDE POINT BRIDGE, PITTSBURGH, PA.

All surfaces of the structure that will be exposed to view after completion, including the outside surfaces of the piers and retaining walls for a depth of twelve (12) inches below the finished surface of the ground except the intrados of the arch rings and underside of the floor slab over the P. W. Railroad undergrade crossing, shall be finished in the following manner:

As the concrete is placed it shall be thoroughly and carefully spaded against the forms to insure a smooth, true surface. The forms shall be removed from the surfaces in not less than eighteen (18) hours nor more than forty-eight (48) hours after placing concrete. Immediately after removing the forms, the surfaces shall be rubbed with suitable appliances to fully remove all form marks, surface irregularities and outer cement skin, leaving the surfaces plane, true and of a uniform sandy finish.

The surfaces of the intrados of the arch rings and underside of the floor slab over the P. & W. Railroad undergrade crossing where the forms cannot be removed in less than twenty (20) days after concreting, shall be rubbed with suitable appliances to remove unsightly form marks and fins.

If you loathed the subject of names, and had resolved never again to introduce it, and some one should inform you that W. H. Crobar was a railway section foreman at Taylor, Wis., what would you do?—B. L. T., in Chicago Tribune.

COMMITTEE ASSIGNMENTS, A. R. E. A.

The American Railway Engineering Association has assigned committee work for the year 1914, this work and personnel of committees being as follows:

Roadway, Committee I.

W. M. Dawley (chairman), assistant engineer, Erie R. R., New York, N. Y.; J. A. Spielmann (vice-chairman), district engineer B. & O. R. R., Pittsburgh, Pa.; J. R. W. Ambrose, chief engineer, Toronto Terminals Co., Toronto, Canada; A. F. Blaess, engineer M. W., I. C. R. R., Chicago, Ill.; M. J. Corrigan, general inspector of tunnels, B. & O. R. R., Cumberland, Md.; Ward Crosby, chief engineer, C. & O. Ry., Johnson City, Tenn.; W. C. Curd, drainage engineer, M. P. Ry., St. Louis, Mo.; Paul Diddler, principal assistant engineer, B. & O. R. R., Pittsburgh, Pa.; R. C. Falconer, superintendent of construction, Erie R. R., New York, N. Y.; S. B. Fisher, chairman, valuation committee, M. & T. Ry., St. Louis, Mo.; Frank Merritt, chief engineer, B. & O. R. R., Galveston, Tex.; L. G. Morphy, designing engineer, B. & O. R. R., Boston, Mass.; F. M. Patterson, chief engineer, C. & O. Ry., St. Louis, Mo.; W. D. Pence, member engineering board, Interstate Commerce Commission, Chicago, Ill.; L. M. Perkins, engineer maintenance of way, N. P. Ry., Tacoma, Wash.; W. H. Petersen, engineer maintenance of way, C. & N. W. Ry., Des Moines, Iowa; A. C. Prime, engineer Penn. R. R., Philadelphia, Pa.; H. J. Silfer, consulting civil engineer, 209 South LaSalle Street, Chicago, Ill.; J. E. Willoughby, assistant chief engineer, A. C. L. R. R., Wilmington, N. C.; W. P. Wiltsee, assistant engineer, N. & W. Ry., Norfolk, Va.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue the study of unit pressure allowable on roadbed of different materials, conferring with Committee on Ballast and with Special Committee on Stresses in Track.
2. Submit specifications for protection of slopes by sodding or otherwise.
3. Recommend means for prevention or cure, as case may be, of water pockets in roadbed.

Ballast, Committee II.

H. E. Hale (chairman), engineer, President's Committee on Valuation, New York; J. M. Meade (vice-chairman), engineer, Eastern Lines, A. T. & S. F. Ry., Topeka, Kan.; L. W. Baldwin, superintendent, I. C. R. R., Louisville, Ky.; D. P. Beach, division engineer, Penn. L. W., Indianapolis, Ind.; W. J. Bergen, assistant to chief engineer, N. Y. C. & St. L. Ry., Cleveland, O.; T. C. Burpee, superintendent engineer, Intercolonial Ry., Moncton, N. B.; O. H. Crittenden, chief engineer, I. & G. N. Ry., Houston, Tex.; J. M. Egan, superintendent, I. C. R. R., Water Valley, Miss.; T. W. Fatherson, assistant engineer, C. & N. W. Ry., El Reno, Okla.; H. L. Gordon, assistant engineer, B. & O. R. R., Baltimore, Md.; G. H. Harris, engineer of track, M. C. R. R., Detroit, Mich.; C. C. Hill, engineer of construction, M. C. R. R., Detroit, Mich.; S. A. Jordan, district engineer, B. & O. R. R., Baltimore, Md.; William McNab (past-president), principal assistant engineer, G. T. Ry., Montreal, Canada; S. B. Rice, engineer maintenance of way, Richmond, Fredericksburg & Potomac R. R., Richmond, Va.; E. V. Smith, division engineer, B. & O. R. R., Newark, O.; D. L. Sommerville, superintendent, N. Y. C. & H. R. R., Utica, N. Y.; F. J. Stimson, division engineer, G. R. & I. Ry., Grand Rapids, Mich.; D. W. Thrower, district engineer, I. C. R. R., Memphis, Tenn.; R. C. White, engineer maintenance of way, M. P. Ry., Little Rock, Ark.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue investigation of proper depth of ballast of various kinds to insure uniform distribution of loads on roadway, conferring with other committees.
2. Continue study of subject of ballast sections, with particular reference to the use of a sub- and top-ballast.

Ties, Committee III.

L. A. Downs (chairman), superintendent, I. C. R. R., Dubuque, Iowa; G. W. Merrell (vice-chairman), assistant to general manager, N. & W. Ry., Roanoke, Va.; C. C. Albright, assistant professor of civil engineering, Purdue University, Lafayette, Ind.; W. J. Burton, assistant engineer, M. P. Ry., St. Louis, Mo.; W. A. Clark, chief engineer, D. & I. R. R., Duluth, Minn.; S. B. Clement, chief engineer, Temiskaming & Northern Ontario Ry., North Bay, Ont.; E. D. Jackson, division engineer, B. & O. R. R., Philadelphia, Pa.; E. P. Laird, engineer of roadway, A. C. L. R. R., Rocky Mount, N. C.; F. R. Layne, engineer of track, B. & L. E. R. R., Greenville, Pa.; E. R. Lewis, assistant to general manager, D. S. & A. Ry., Duluth, Minn.; J. B. Myers, division engineer, B. & O. R. R., Cumberland, Md.; J. V. Neubert, engineer of track, N. Y. C. & H. R. R., New York; R. J. Parker, general superintendent, A. T. & S. F. Ry., Topeka, Kan.; J. G. Shillinger, chief engineer, Rutland R. R., Rutland, Vt.; I. O. Walker, assistant engineer, N. C. & St. L. Ry., Paducah, Ky.; H. S. Wilgus, engineer maintenance of way, Pittsburg, Shawmut & Northern R. R., Angelica, N. Y.; Louis Yager, division engineer, N. P. Ry., St. Paul, Minn.; E. C. Young, supervisor, New York, Philadelphia & Norfolk R. R., Cape Charles, Va.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue study of the effect of design of tie-plates and track spikes on the durability of cross-ties.
2. Continue study on economy in track labor and material effected through the use of treated compared with untreated cross-ties.
3. Continue study of metal, composite and concrete cross-ties, building up a history of same.
4. Investigate and report on the future timber supply for ties.
5. Report on the distribution and care of cross-ties.

Rail, Committee IV.

J. A. Atwood (chairman), chief engineer, P. & L. E. R. R., Pittsburgh, Pa.; W. C. Cushing (past-president-vice-chairman), chief engineer maintenance of way, Penn. Lines West, Pittsburgh, Pa.; E. B. Ashby, chief engineer, L. V. R. R., New York, N. Y.; A. S. Baldwin (second vice-president), chief engineer, I. C. R. R., Chicago, Ill.; Chas. S. Churchill (past-president), assistant to president, N. &

W. Ry., Roanoke, Va.; J. B. Berry, consulting engineer, Chicago, Ill.; G. M. Davidson, chemist and engineer of tests, C. & N. W. Ry., Chicago, Ill.; F. A. Delano (director), president, C. & I. & L. Ry., Chicago, Ill.; P. H. Dudley, consulting engineer, New York Central Lines, New York, N. Y.; C. F. W. Felt, chief engineer, A. T. & S. F. Ry., Chicago, Ill.; L. C. Fritch (past-president), assistant to president, C. N. Ry., Toronto, Canada; A. W. Gibbs, chief mechanical engineer, Pennsylvania R. R., Philadelphia, Pa.; A. H. Hogeland, consulting engineer, G. N. Ry., St. Paul, Minn.; C. W. Huntington, vice-president and general manager, M. & St. L. Ry., Minneapolis, Minn.; John D. Isaacs, consulting engineer, S. P. Co., New York, N. Y.; Thos. H. Johnson, consulting engineer, Pennsylvania Lines West, Pittsburgh, Pa.; Howard G. Kelley (past-president), G. T. Ry. System, Montreal, Canada; C. F. Loweth, chief engineer, C. M. & St. P. Ry., Chicago, Ill.; H. B. MacFarland, engineer of tests, A. T. & S. F. Ry., Chicago, Ill.; R. Montfort, consulting engineer, L. & N. R. R., Louisville, Ky.; C. A. Morse (director), chief engineer, C. R. I. & P. Ry., Chicago, Ill.; J. R. Ondonk, engineer of tests, H. & O. R. R., Baltimore, Md.; J. P. Snow, consulting engineer, Boston, Mass.; F. S. Stevens, engineer maintenance of way, P. & R. Ry., Reading, Pa.; A. W. Thompson, third vice-president, B. & O. Ry., Baltimore, Md.; R. Trimble (first vice-president), chief engineer maintenance of way, Penn. Lines West, Pittsburgh, Pa.; Geo. W. Vaughan, engineer maintenance of way, N. Y. C. & H. R. R., New York, N. Y.; M. H. Wickhorst, engineer of tests, Rail Committee, Chicago, Ill.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Recommend standard rail sections.
2. Continue investigations of rail failures and deduce conclusions therefrom.
3. Continue special investigation of rails.
4. Present specifications for material in rail joints.

Track, Committee V.

J. B. Jenkins (chairman), valuation engineer, B. & O. R. R., Baltimore, Md.; G. J. Ray (director-vice-chairman), chief engineer, D. L. & W. R. R., Hoboken, N. J.; Geo. H. Bremner (treasurer), assistant district engineer, Interstate Commerce Commission, Chicago, Ill.; H. M. Church, district engineer, B. & O. R. R., Wheeling, W. Va.; Garrett Davis, division engineer, C. R. I. & P. Ry., El Reno, Okla.; J. M. R. Fairbairn, assistant chief engineer, C. P. Ry., Montreal, Canada; T. H. Hickey, roadmaster, M. C. R. R., St. Thomas, Ont.; E. T. Howson, civil engineering editor, Railway Age-Gazette, Chicago, Ill.; L. J. F. Hughes, division engineer, C. R. I. & P. Ry., Herington, Kan.; T. T. Irving, division engineer, G. T. Ry., Chicago, Ill.; J. R. Leighty, engineer maintenance of way, C. P. Ry., Kansas City, Mo.; A. C. Mackenzie, engineer maintenance of way, C. P. Ry., Montreal, Canada; P. C. Newbegin, maintenance engineer, Bangor & Aroostock R. R., Houlton, Me.; F. B. Oren, roadmaster, I. C. R. R., Carbondale, Ill.; R. M. Pearce, resident engineer, P. & L. E. R. R., Pittsburgh, Pa.; H. T. Porter, chief engineer, B. & L. E. R. R., Greenville, Pa.; E. Raymond, general superintendent, A. T. & S. F. Ry., Newton, Kan.; W. G. Raymond, dean, College of Applied Science, State University of Iowa, Iowa City, Iowa; L. S. Rose, valuation engineer, C. C. & St. L. Ry., Cincinnati, Ohio; H. R. Safford, chief engineer, G. T. Ry., Montreal, Canada; C. H. Stein, superintendent, C. R. R. of N. J., Jersey City, N. J.; W. I. Trench, division engineer, B. & O. R. R., Baltimore, Md.; A. H. Stone, office engineer, K. C. T. Ry., Kansas City, Mo.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Typical plans for double slip crossings, double crossovers and guard rails.
2. Study the relation between worn flanges and worn switch points, with a view to correcting the causes and decreasing the number of derailments due to the combination of worn switch points and worn flanges on wheels.
3. Continue the study of economics of track labor.
4. Report on the design of manganese frogs and crossings.

Buildings, Committee VI.

M. A. Long (chairman), assistant to chief engineer, B. & O. R. R., Baltimore, Md.; G. H. Gilbert (vice-chairman), engineer bridges and buildings, Queen & Crescent Route, Cincinnati, Ohio; G. W. Andrews, inspector of maintenance, B. & O. R. R., Baltimore, Md.; J. P. Canty, supervisor of bridges and buildings, Boston & Maine R. R., Boston, Mass.; D. R. Collin, architect, N. Y. C. & H. R. R., New York, N. Y.; C. G. Delo, chief engineer, C. G. W. R. R., Chicago, Ill.; W. T. Dorrance, chief engineer, East Boston Terminal R. R., Boston, Mass.; C. H. Fake, chief engineer, Mississippi River & Bonne Terre Ry., Bonne Terre, Mo.; A. T. Hawk, architect, C. R. I. & P. Ry., Chicago, Ill.; H. A. Lloyd, assistant engineer, Erie R. R., Jersey City, N. J.; P. B. Roberts, office engineer, G. T. Ry., Montreal, Canada; W. S. Thompson, division engineer, Pennsylvania R. R., Sunbury, Pa.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Report on methods of heating, lighting and sanitary provisions for medium-sized stations.
2. Continue the study of the advantages and disadvantages of the various designs of freight houses and shop floors.
3. Present data on rest houses for employees.

Wooden Bridges and Trestles, Committee VII.

E. A. Frink (chairman), bridge engineer, S. A. L. Ry., Portsmouth, Va.; W. H. Hoyt (vice-chairman), assistant chief engineer, D. M. & N. Ry., Duluth, Minn.; H. Austill, Jr., bridge engineer, M. & O. R. R., Mobile, Ala.; J. E. Barrett, superintendent of track, bridges and buildings, L. & H. R. R. R., Warwick, N. Y.; F. E. Bissell, civil engineer, Cleveland, Ohio; H. C. Brown, Jr., assistant engineer, I. C. R. R., Chicago, Ill.; E. A. Hadley, assistant engineer, M. P. Ry., St. Louis, Mo.; F. G. Hoskins, assistant engineer, B. & O. R. R., Foxburg, Pa.; H. S. Jacoby, professor of bridge engineering, Cornell University, Ithaca, N. Y.; A. O. Ridgway, assistant chief engineer, D. M. & N. Ry., Denver, Colo.; I. L. Simmons, bridge engineer, C. R. I. & P. Ry., Chicago, Ill.; D. W. Smith, engineer of construction, H. V. Ry., Columbus, Ohio; W. F. Steffens, special engineer, New York Central Lines, New York.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue study of relative economy of repairs and renewals of wooden bridges and trestles.
2. Report on design of docks and wharves.
3. Report on developments in practice of ballast deck trestles since previous report.
4. Report on use of lag-screws for fastening guard timbers.

Masonry, Committee VIII.

F. E. Schall (chairman), bridge engineer, L. V. R. R., S. Bethlehem, Pa.; F. L. Thompson (vice-chairman), assistant chief engineer, I. C. R. R., Chicago, Ill.; R. Armour, masonry engineer, G. T. Ry. Montreal, Canada; John C. Beye, Chicago, Ill.; C. W. Boynton, chief inspecting engineer, Universal Portland Cement Co., Chicago, Ill.; H. A. Cassil, division engineer, B. & O. S. W. R. R., Seymour, Ind.; T. L. Condon, consulting engineer, Monadnock Block, Chicago, Ill.; J. K. Conner, chief engineer, L. E. & W. R. R., Indianapolis, Ind.; L. J. Hotchkiss, Chicago, Ill.; Richard L. Humphrey, Consulting Engineer and Chemist, Philadelphia, Pa.; J. H. Prior, assistant engineer, State Utilities Board, Chicago, Ill.; R. A. Rutledge, chief engineer, Eastern Lines, A., T. & S. F. Ry., Topeka, Kan.; G. H. Scribner, Jr., contracting engineer, Chicago, Ill.; Job Tutbill, engineer buildings, K. C. T. Ry., Kansas City, Mo.; J. J. Yates, bridge engineer, C. R. R. of N. Y., New York, N. Y.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Complete report on principles of design of plain and reinforced retaining walls and abutments.
2. Collect data concerning cost and method of constructing concrete piles, and make recommendations as to their use.
3. Report upon the cost, appearance and wearing qualities of various methods of surface finish for concrete.

Signs, Fences and Crossings, Committee IX.

W. F. Strouse (chairman), assistant engineer, B. & O. R. R.; G. E. Boyd (vice-chairman), division engineer, D. L. & W. R. R., Buffalo, N. Y.; R. B. Abbott, division engineer, P. & R. Ry., Harrisburg, Pa.; H. E. Billman, general roadmaster M. P. Ry., St. Louis, Mo.; E. T. Brown, division engineer, B. & O. R. R., Grafton, W. Va.; A. C. Copland, assistant engineer, C. & O. Ry., Richmond, Va.; Arthur Crumpton, assistant engineer, G. T. Ry., Montreal, Canada; J. T. Frame, engineer M. W. C. G. W. R. R., St. Paul, Minn.; L. E. Haislip, division engineer, B. & O. R. R., Parkersburg, W. Va.; Maro Johnson, engineer bridges and buildings, I. C. R. R., Chicago, Ill.; L. C. Lawton, division engineer, A., T. & S. F. Ry., Newton, Kan.; G. L. Moore, engineer maintenance of way, L. V. R. R., South Bethlehem, Pa.; Thomas Quigley, roadmaster, I. C. R. R., Dubuque, Iowa; C. H. Splitstone, chief draftsman, Erie R. R., New York, N. Y.; W. D. Williams, chief engineer, Cincinnati Northern Ry., Van Wert, Ohio.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Report on the economy of concrete and metal signs and signals as compared with wood.
2. Report on the economy of concrete and metal as compared with wood for fence posts.
3. Investigate methods used and comparative cost of repainting crossing and other signs; also present specifications for whitewashing cattle-guard wing fences.

Signals and Interlocking, Committee X.

Thos. S. Stevens (chairman), signal engineer, A. T. & S. F. Ry., Topeka, Kan.; C. C. Anthony (vice-chairman), assistant signal engineer, Pennsylvania R. R., Philadelphia, Pa.; Axel Ames, consulting engineer, New York, N. Y.; H. S. Ballett, assistant terminal manager, Grand Central Terminal, New York, N. Y.; J. B. Cameron, division engineer, B. & O. R. R., New Castle, Pa.; W. B. Causey, superintendent, C. G. W. R. R., St. Paul, Minn.; C. A. Christofferson, signal engineer, N. P. Ry., St. Paul, Minn.; C. E. Denney, special engineer, L. S. & M. S. Ry., Chicago, Ill.; C. A. Dunham, signal engineer, G. N. Ry., St. Paul, Minn.; W. J. Eck, electrical engineer, Southern Ry., Washington, D. C.; W. H. Elliott, signal engineer, N. Y. C. & H. R. R., Albany, N. Y.; G. E. Ellis, signal engineer, K. C. T. Ry., Kansas City, Mo.; M. H. Hovey, consulting engineer, Madison, Wis.; A. S. Ingalls, general superintendent, L. S. & M. S. Ry., Cleveland, Ohio; A. M. Keppel, superintendent, Washington Terminal Co., Washington, D. C.; J. C. Mock, electrical engineer, Detroit River Tunnel Co., Detroit, Mich.; F. P. Paternal, signal engineer, B. & O. R. R., Baltimore, Md.; J. A. Peabody, signal engineer, C. & N. W. Ry., Chicago, Ill.; D. W. Richards, signal engineer, N. & W. Ry., Roanoke, Va.; A. H. Rudd, signal engineer, Pennsylvania R. R., Philadelphia, Pa.; W. B. Scott (director), president, Sunset Central Lines, Houston, Tex.; A. G. Shaver, Chicago, Ill.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue study of economics of labor in signal maintenance.
2. Formulate and present requisites for switch indicators, including conveying information on condition of the block to conductor and engineer.
3. Present, for approval, specifications adopted by the Railway Signal Association, which in the judgment of the committee warrants consideration.
4. Study the problem of signaling single-track roads with reference to the effect of signaling and proper location of passing sidings on the capacity of the line.

Records and Accounts, Committee XI.

W. A. Christian (chairman), first assistant engineer, C. G. W. R. R., Chicago, Ill.; M. C. Byers (vice-chairman), assistant to president, G. N. Ry., St. Paul, Minn.; F. J. Bachelder, division engineer, B. & O. R. R., Cleveland, Ohio; W. S. Danes, engineer maintenance of way, Wabash R. R., Peru, Ind.; Lester Bernstein, statistician, B. & O. R. R., Baltimore, Md.; G. D. Hill, assistant engineer, I. C. R. R., Dubuque, Iowa; Huntington Smith, division engineer, N. Y. C. & St.

L. R. R., Cleveland, Ohio; Henry Lehn, maintenance of way accountant, N. Y. C. & H. R. R. R., New York, N. Y.; J. H. Milburn, chief draftsman, B. & O. R. R., Baltimore, Md.; J. W. Orrock, principal assistant engineer, C. P. Ry., Montreal, Canada; J. C. Patterson, chief draftsman, Erie R. R., New York, N. Y.; H. C. Phillips, valuation engineer, A., T. & S. F. Ry., Chicago, Ill.; F. H. Reinholdt, principal assistant engineer, M. & St. L. R. R., Minneapolis, Minn.; R. C. Sattley, valuation engineer, C. R. I. & P. Ry., Chicago, Ill.; Guy Scott, division engineer, Pennsylvania Lines West, Fort Wayne, Ind.; H. M. Stout, record engineer, N. P. Ry., St. Paul, Minn.; Frank Taylor, right-of-way and lease agent, C. F. Ry., Montreal, Canada; J. L. Vollintine, valuation department, C., B. & Q. R. R., Chicago, Ill.; W. D. Wiggins, valuation engineer, Pennsylvania Lines West, Pittsburgh, Pa.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Make a comprehensive study of the forms in the Manual, adopted a number of years ago, and bring forms up to date.
2. Continue the study of reports required by Federal and State Railway Commissions.
3. Continue the study of a feasible and useful subdivision of I. C. C. Classification Account No. 6, with a view to securing uniformity of labor costs.

Rules and Organization, Committee XII.

G. D. Brooke (chairman), superintendent, B. & O. R. R., Chillicothe, O.; F. D. Anthony (vice-chairman), construction engineer, D. & H. Co., Albany, N. Y.; R. P. Black, engineer maintenance of way, Kanawha & Michigan Ry., Charleston, W. Va.; L. L. Beal, chief engineer, A., B. & A. R. R., Atlanta, Ga.; Ralph Budd, chief engineer, G. N. Ry., St. Paul, Minn.; A. M. Burt, chief engineer maintenance of way, N. P. Ry., St. Paul, Minn.; J. B. Carothers, assistant to general manager, B. & O. S. W. R. R., Cincinnati, Ohio; S. E. Coombs, assistant engineer, N. Y. C. & H. R. R., New York, N. Y.; C. Dougherty (director), chief engineer, Queen & Crescent Route, Cincinnati, Ohio; B. Herman, chief engineer maintenance of way and structures, Southern Ry., Washington, D. C.; Jos. Muller, engineer maintenance of way, C., C. & St. L. Ry., Gallon, Ohio; E. T. Reisler, division engineer, L. V. R. R., Buffalo, N. Y.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Review Rules and Instructions heretofore adopted by the association and recommend such changes and additions thereto as may seem desirable.
2. Formulate rules for the guidance of the Maintenance of Way Department pertaining to safety.
3. Continue the formulation of rules for the guidance of field parties:
 - (a) When making preliminary surveys.
 - (b) When making location surveys.
 - (c) When in charge of construction.
4. Continue the study of science of organization.

Water Service, Committee XIII.

A. F. Dorley (chairman), engineer water service, M. P. Ry., St. Louis, Mo.; J. L. Campbell (vice-chairman), engineer maintenance of way, E. P. & S. W. Sys., El Paso, Tex.; J. T. Andrews, assistant engineer, B. & O. R. R., Baltimore, Md.; F. T. Beckett, engineer maintenance of way, C. R. I. & P. Ry., El Reno, Okla.; C. C. Cook, division engineer, B. & O. R. R., Pittsburgh, Pa.; J. L. Downs, roadmaster, I. C. R. R., Memphis, Tenn.; R. H. Gaines, division engineer, K. C. S. Ry., Texarkana, Tex.; W. S. Lacher, office engineer, C. M. & St. P. Ry., Chicago, Ill.; E. G. Lane, assistant engineer, B. & O. R. R., Baltimore, Md.; W. A. Parker, chief engineer, St. J. & G. I. Ry., St. Joseph, Mo.; R. W. Willis, district engineer, C., B. & Q. R. R., Chicago, Ill.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Complete report on design and relative economy of track pans from an operating standpoint.
2. Report on deep well and deep well pumping and relative economy of this as compared with other sources of water supply.
3. Report on the use of compounds in locomotive boilers to counteract:
 - (a) Foaming.
 - (b) Scale formation.
4. Continue the study of recent developments in pumping machinery, and various kinds of fuels used.

Yards and Terminals, Committee XIV.

E. B. Temple (chairman), assistant chief engineer, Pennsylvania R. R., Philadelphia, Pa.; B. H. Mann (vice-chairman), signal engineer, M. P. Ry., St. Louis, Mo.; W. G. Arn, roadmaster, I. C. R. R., Mattoon, Ill.; H. Baldwin, superintendent, C., C. & St. L. Ry., Mattoon, Ill.; G. H. Burgess, chairman, valuation committee, D. & H. Co., Albany, N. Y.; A. E. Clift, general superintendent, I. C. R. R., Chicago, Ill.; L. G. Curtis, district engineer, B. & O. C. T. R. R., Chicago, Ill.; H. T. Douglas, Jr., chief engineer, C. & A. Ry., Chicago, Ill.; A. C. Everham, assistant chief engineer, K. C. T. Ry., Kansas City, Mo.; R. Ferriday, engineer maintenance of way, C. C. & St. L. Ry., Indianapolis, Ind.; G. H. Herold, office engineer, Department of Public Works, St. Paul, Minn.; D. B. Johnston, division engineer, Pennsylvania Lines West, Louisville, Ky.; H. A. Lane, assistant engineer surveys, B. & O. R. R., Baltimore, Md.; B. M. McDonald, division engineer, N. Y. C. & H. R. R. R., Buffalo, N. Y.; L. J. McIntyre, assistant engineer, N. P. Ry., St. Paul, Minn.; A. Montzheim, chief engineer, E., J. & E. Ry., Joliet, Ill.; H. J. Pfeiffer, engineer maintenance of way, Terminal R. R. Association, St. Louis, Mo.; S. S. Roberts, consulting engineer, Chicago, Ill.; W. L. Seddon, assistant to president, S. A. L. Ry., Norfolk, Va.; C. H. Spencer, assistant district engineer, Interstate Commerce Commission, Washington, D. C.; E. E. R. Trattman, resident editor, Engineering News, Chicago, Ill.; E. P. Weatherly, engineer maintenance of way, K. C. T. Ry., Kansas City, Mo.; W. L. Webb, district engineer, C. M. & St. P. Ry., Chicago, Ill.; C. C. Wentworth, principal assistant engineer, N. & W. Ry., Roanoke, Va.; J. G. Wishart, chief draftsman, C. R. I. & P. Ry., Chicago, Ill.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Report on typical situation plans of passenger stations, of both through and stub types, with critical analysis of working capacity, and include a review of the different methods of estimating their capacity.
2. Report on developments in the handling of freight by mechanical means.
3. Report on developments in the design and operation of hump yards.
4. Continue study of track scales.

Iron and Steel Structures, Committee XV.

A. J. Himes (chairman), engineer grade elimination, N. Y. C. & St. L. R. R., Cleveland, Ohio; O. E. Selby (vice-chairman), bridge engineer, C. C. & St. L. Ry., Cincinnati, Ohio; J. A. Bohland, bridge engineer, G. N. Ry., St. Paul, Minn.; W. S. Bouton, engineer bridges and buildings, B. & O. R. R., Baltimore, Md.; A. W. Buel, consulting bridge engineer, New York, N. Y.; A. W. Carpenter, valuation engineer, N. Y. C. & H. R. R. R., New York, N. Y.; Charles Chandler, assistant bridge engineer, I. C. R. R., Chicago, Ill.; C. L. Crandall, Professor Railway Engineering, Cornell University, Ithaca, N. Y.; J. E. Crawford, chief engineer, N. & W. Ry., Roanoke, Va.; F. O. Dufour, senior structural engineer, Interstate Commerce Commission, Chicago, Ill.; W. R. Edwards, senior structural engineer, Interstate Commerce Commission, Washington, D. C.; A. Chas. Irwin, squad foreman, C. M. & St. P. Ry., Chicago, Ill.; B. R. Lefler, bridge engineer, L. S. & M. S. Ry., Cleveland, Ohio; W. H. Moore, engineer of structures, N. Y. N. H. & H. R. R., New Haven, Conn.; P. B. Motley, engineer of bridges, C. P. Ry., Montreal, Canada; Albert Reichmann, resident engineer, American Bridge Co., Chicago; C. E. Smith, assistant chief engineer, M. P. Ry., St. Louis, Mo.; H. B. Stuart, structural engineer, T. Ry., Montreal, Canada; G. E. Tebbetts, bridge engineer, C. T. Ry., Kansas City, Mo.; F. E. Turneure, dean, College of Engineering, University of Wisconsin, Madison, Wis.; L. F. Van Hagan, assistant professor, University of Wisconsin, Madison, Wis.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Report on the methods of protection of iron and steel structures against corrosion.
2. Study designs and report on built-up columns, co-operating with other investigators and committees of other associations.
3. Report on design, length and operation of turntables.
4. Report on relative economy of various types of movable bridges.

Economics of Railway Location, Committee XVI.

John G. Sullivan (director—Chairman), chief engineer, Western Lines, C. P. Ry., Winnipeg, Man., Can.; C. P. Howard (vice-chairman), consulting engineer, Chicago, Ill.; F. H. Alfred, general manager, P. M. R. R., Detroit, Mich.; R. N. Begala, general superintendent, B. & O. S. W. R. R., Cincinnati, Ohio; J. F. Burns, assistant engineer maintenance of way, L. & N. R. R., Louisville, Ky.; Maurice Coburn, principal assistant engineer, Vandalia R. R., St. Louis, Mo.; A. C. Dennis, contracting engineer, Winnipeg, Man.; A. S. Going, engineer of construction, G. T. Ry., Montreal, Canada; F. W. Green, general manager, Louisiana & Arkansas Ry., Stamps, Ark.; L. C. Hartley, chief engineer, C. & E. I. R. R., Chicago, Ill.; P. M. LaBach, assistant engineer, C. R. I. & P. Ry., Chicago, Ill.; Fred Lavis, consulting engineer, New York; J. de N. Macomb, office engineer, A. T. & S. F. Ry., Topeka, Kan.; C. W. P. Ramsey, engineer of construction, C. P. Ry., Montreal, Canada; E. C. Schmidt, Professor in Railway Engineering, University of Illinois, Urbana, Ill.; A. K. Shurtleff (director), C. R. I. & P. Ry., Chicago, Ill.; H. J. Simmons, general manager, E. P. & S. W. Ry., El Paso, Tex.; F. W. Smith, contracting engineer, Cincinnati, O.; Walter Loring Webb, public utility engineer, Philadelphia, Pa.; M. A. Zook, resident engineer, Interstate Commerce Commission, Washington, D. C.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Study the question of grade, curvature, rise and fall, and distance, and, if possible, present conclusions as to reasonable values of same in a usable form, in order that they may be of use for the information and guidance of locating engineers.
2. Continue the important study of economics of railway operation heretofore carried on by the Committee, in order that the information may lead to more economical methods in railway operation and that information may be obtained for correcting values given to the physical features in the locating of railways.
3. Make special efforts to collect information in regard to effects of passenger and freight traffic on the cost of maintenance.

Wood Preservation, Committee XVII.

Earl Stimson (director—chairman), engineer maintenance of way, B. & O. R. R., Baltimore, Md.; E. H. Bowser (vice-chairman), superintendent timber department, I. C. R. R., Memphis, Tenn.; H. B. Dick, B. & O. S. W. R. R., Cincinnati, Ohio; C. F. Ford, supervisor and timber department, C. R. I. & P. Ry., Chicago, Ill.; Dr. W. K. Hatt, Professor of Civil Engineering, Purdue University, Lafayette, Ind.; V. K. Hendricks, assistant chief engineer, St. L. & S. F. R. R., St. Louis, Mo.; Jos. O. Osgood, chief engineer, C. R. R. of N. J., New York, N. Y.; George E. Rex, manager treating plants, A. T. & S. F. Ry., Topeka, Kan.; E. A. Sterling, consulting forester, Philadelphia, Pa.; C. M. Taylor, superintendent treating plants, C. R. R. of N. J. and P. & R. Ry., Port Reading, N. J.; Dr. Herman von Schrenk, consulting timber engineer, C. R. I. & P. Ry., C. & E. I. R. R. and New York Central Lines, St. Louis, Mo.; T. G. Townsend, timber treating inspector, Southern Ry., Washington, D. C.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue the study of the use of coal tar in creosote oil.
2. Continue the compilation of available information from service tests, supplementing this with reports of inspections to be made by members of the Committee, of those sections of test track that have been in service long enough to give results.
3. Present specifications for timber to be treated.

4. Report on methods of accurately determining the absorption of creosote oil.
5. Study the subject of water in creosote.

Electricity, Committee XVIII.

George W. Kittredge (past-president—chairman), chief engineer, N. Y. C. & H. R. R. R., New York, N. Y.; J. B. Austin, Jr. (vice-chairman), superintendent, L. I. R. R., Jamaica, N. Y.; D. J. Brumley, valuation engineer, I. C. R. R., Chicago, Ill.; R. D. Coombs, consulting engineer, New York, N. Y.; A. O. Cunningham, chief engineer, Wabash, R. R., St. Louis, Mo.; J. H. Davis, electrical engineer, B. & O. R. R., Baltimore, Md.; Walt Dennis, assistant engineer, C. R. I. & P. Ry., Chicago, Ill.; George Gibbs, consulting engineer, Pennsylvania R. R., New York, N. Y.; G. A. Harwood, chief engineer electric zone improvements, N. Y. C. & H. R. R. R., New York, N. Y.; E. B. Katte, chief engineer electric traction, N. Y. C. & H. R. R. R., New York, N. Y.; C. E. Lindsay, division engineer, N. Y. C. & H. R. R. R., Albany, N. Y.; W. L. Morse, chief engineer, Jacksonville Terminal Co., Jacksonville, Fla.; W. S. Murray, consulting engineer, New Haven, Conn.; J. A. Peabody, signal engineer, C. & N. W. Ry., Chicago, Ill.; J. W. Reid, bridge engineer, C. & A. Ry., Chicago, Ill.; Frank Rhea, district engineer, Interstate Commerce Commission, Washington, D. C.; A. F. Robinson, bridge engineer, A. T. & S. F. Ry., Chicago, Ill.; J. R. Savage, chief engineer, L. I. R. R., Jamaica, N. Y.; Martin Schreiber, engineer maintenance of way, Public Service Ry., Newark, N. J.; A. G. Shaver, Chicago, Ill.; H. U. Wallace, vice-president, Northern Colorado Power Co., Boulder, Colo.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue study of the effect of electrolytic action on metallic structures and best means of preventing it.
2. Continue the preparation of a standard specification for overhead transmission line crossings.
3. Continue the study of electrolysis and insulation and its effect upon reinforced concrete structures.
4. Report on maintenance organization with relation to track structures.

Conservation of Natural Resources, Committee XIX.

C. H. Fisk (chairman), consulting engineer, St. Louis, Mo.; A. W. Carpenter (vice-chairman), valuation engineer, N. Y. C. & H. R. R. R., New York, N. Y.; R. H. Alston, vice-president, C. & N. W. Ry., Chicago, Ill.; Moses Burpee, chief engineer, B. & A. R. R., Houlton, Me.; F. F. Busted, general superintendent, C. P. Ry., Vancouver, B. C.; A. L. Davis, office engineer, I. C. R. R., Chicago, Ill.; W. A. Hammel, purchasing agent, A. B. & A. R. R., Atlanta, Ga.; William McNab (past-president), principal assistant engineer, G. T. Ry., Montreal, Canada; G. A. Mountain, chief engineer, Canadian Railway Commission, Ottawa, Canada; A. L. Moorshead, resident engineer, Erie R. R., New York, N. Y.; J. Frank Lee Stuart, chief engineer, B. & O. R. R., Baltimore, Md.; S. N. Williams, Professor of Civil Engineering, Cornell College, Mt. Vernon, Iowa; R. C. Young, chief engineer, Lake Superior & Ishpeming Ry., Marquette, Mich.

Outline of Work.

1. Continue the study of tree planting and general reforestation.
2. Continue the study of coal, fuel, oil and timber resources.
3. Continue the study of iron and steel resources.

Stresses in Track, Special Committee.

A. N. Talbot (chairman), Professor of Municipal and Sanitary Engineering, University of Illinois, Urbana, Ill.; W. M. Dawley (vice-chairman), assistant engineer, Erie R. R., New York, N. Y.; A. S. Baldwin (second vice-president), chief engineer, I. C. R. R., Chicago, Ill.; J. B. Berry, consulting engineer, Chicago, Ill.; C. H. Brenner (treasurer), assistant district engineer, Interstate Commerce Commission, Chicago, Ill.; John Brunner, assistant inspecting engineer, Illinois Steel Co., Chicago, Ill.; W. J. Burton, assistant engineer, M. P. Ry., St. Louis, Mo.; Chas. S. Churchill (past-president), assistant to president, N. & W. Ry., Roanoke, Va.; W. C. Cushing (past-president), chief engineer maintenance of way, Pennsylvania Lines West, Pittsburgh, Pa.; Dr. P. H. Dudley, consulting engineer, New York Central Lines, New York, N. Y.; Emil Gerber, assistant to president, American Bridge Co., Pittsburgh, Pa.; H. E. Hale, engineer, President's Committee on Valuation, New York, N. Y.; Robt. W. Hunt, consulting engineer, Chicago, Ill.; J. B. Jenkins, valuation engineer, B. & O. R. R., Baltimore, Md.; George W. Kittredge (past president), chief engineer, N. Y. C. & H. R. R. R., New York, N. Y.; P. M. LaBach, assistant engineer, C. R. I. & P. Ry., Chicago, Ill.; William McNab (past-president), principal assistant engineer, G. T. Ry., Montreal, Canada; G. J. Ray (director), chief engineer, D. L. & W. R. R., Hoboken, N. J.; Earl Stimson (director), engineer maintenance of way, B. & O. R. R., Baltimore, Md.; F. E. Turneure, dean, College of Engineering, University of Wisconsin, Madison, Wis.; J. E. Willoughby, assistant chief engineer, A. C. L. R. R., Wilmington, N. C.

Grading of Lumber, Special Committee.

Dr. H. Von Schrenk (chairman), consulting timber engineer, St. Louis, Mo.; B. A. Wood (vice-chairman), chief engineer, M. & O. R. R., Mobile, Ala.; W. McC. Bond, division engineer, B. & O. R. R., Chillicothe, Ohio; D. Fairchild, supervisor bridges and buildings, N. P. Ry., St. Paul, Minn.; R. Koehler, purchasing agent, O. W. R. R. & N. C., Portland, Ore.; A. J. Neahe, principal assistant engineer, D. L. & W. R. R., Hoboken, N. J.; W. H. Norris, bridge engineer, Maine Central R. R., Portland, Me.; J. J. Taylor, superintendent bridges and buildings, K. C. S. Ry., Texarkana, Tex.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue the collection of current specifications, grading and inspection rules for maintenance of way timber and lumber not heretofore reported on, and present same for all classes of maintenance of way timber and lumber, which will conserve the interests of railways and be acceptable to manufacturers' associations; conferring with committees of this association and with other organizations whose work is affected.

Uniform General Contract Form, Special Committee.

E. H. Lee (chairman), vice-president and chief engineer, C. & W. I. R. R., Chicago, Ill.; C. A. Wilson (vice-chairman), consulting en-

gineer, Cincinnati, O.: C. Frank Allen, Professor of Railroad Engineering, Massachusetts Institute of Technology, Boston, Mass.; W. G. Atwood, assistant district engineer, Interstate Commerce Commission, Chattanooga, Tenn.; John P. Congdon, consulting engineer, Boise, Idaho; Thos. Earle, superintendent B. & C. department, Pennsylvania Steel Co., Steelton, Pa.; J. C. Irwin, assistant engineer valuation, Boston & Albany, R. R., Boston, Mass.; R. G. Kenly, chief engineer, M. & St. L. R. R., Minneapolis, Minn.; C. A. Paquette, chief engineer maintenance of way, C. C. & St. L. Ry., Cincinnati, Ohio; J. H. Roach, assistant valuation engineer, L. S. & M. S. Ry., Cleveland, O.; H. A. Woods, assistant chief engineer, G. T. P. Ry., Montreal, Canada.

Outline of Work.

Make critical examination of the subject-matter in the Manual, and submit definite recommendations for changes.

1. Continue the study of general contract forms, including forms for bond.

RAILWAY CONSTRUCTION.

The Atchison, Topeka & Santa Fe contemplates building a link from Oakdale, La., to New Orleans, La., 140 miles.

The Santa Fe will rebuild the Kansas Southwestern its entire length between Arkansas City and Anthony, it is said. Work will include rails, bridges, ties, equipment, etc.

The Boise-Payette Lumber Co., Boise, Idaho, has awarded contract to the Wasatch Grading Co., Salt Lake City, Utah, for grading of 14 miles of railroad for the lumber company's Inter-mountain Railroad and work is to be begun at once and completed by October 1, 1914.

The Central of Texas, a road proposed to be built from Harbor Island to Seymour, Quanah and Belton via Lockhart, is securing right of way and will begin immediate work of construction.

The Chesapeake & Ohio Northern, of Maysville, Ky., has filed articles of incorporation in Kentucky. The railroad will connect with the Chesapeake & Ohio at Tygart's Creek in Greenup county, Ky., and extend through to Columbus, Ohio, a distance of 95 miles.

The Chicago, Burlington & Quincy will let contract at once for the construction of the proposed cutoff from Yutan, Neb., to Chalco.

The Walsh Construction Company has been awarded a contract for the reduction of northbound grades of the Chicago & North Western between Radnor, Ill., and the main line connection at Nelson, Ill.

An effort is being made to induce the Chicago, St. Paul, Minneapolis & Omaha to build a branch from Holcombe to Ladysmith, Wis., 18 miles.

The Chicago, Peoria & Quincy has completed most of the surveys and has the right of way arranged for building from the Illinois Traction Company's line at Peoria, Ill., southwest to Quincy, about 120 miles.

The Chicago, Rock Island & Pacific is contemplating construction of a spur from McAlester, Okla., to Ashland, possibly extending on to Sulphur by way of Tupelo, according to press reports.

The Dorr County Peninsula will start work soon, it is said, on a 40-mile line from Sturgeon Bay, Wis., to a point north of that place. E. E. Galle & Company, Plymouth building, Minneapolis, Minn., are interested.

The Delaware, Lackawanna & Western has agreed to elevate the tracks in Syracuse, N. Y.

The Doty Lumber & Shingle Co. has awarded a contract to the North Coast Construction Co., Portland, Ore., for the construction of a logging road to extend north from Doty, Wash.

The Elkin & Alleghany will be financed by I. M. Taylor & Co., Boston, Mass., and the line constructed from Elkin, N. C., through Sparta in Alleghany County to Jefferson, Ashe County.

The Erie has begun double-tracking its line from Pymatuning to New Castle, Pa., a distance of six miles.

A company is being organized to build an electric line from New Smyrna, Fla., it is said. S. E. Carmichael, Lake Helen, Fla., is interested.

The Galveston, Harrisburg & San Antonio has let a contract to Garvin & Davis, Houston, Tex., to build the loop line, from La Porte, Tex., to Seabrook.

The Great Northern has resumed construction on its line from Lewiston, Mont., to New Rockford, entailing the building of about 325 miles. This will materially shorten the route to the

Pacific coast and tap an immense grain territory now without railroad facilities.

The Hocking Valley contemplates a line from Columbus, O., to Toledo, it is reported.

The Indian Creek & Pound River, it is said, will build a 10-mile extension from Pound to Freeling, Va.

The Kansas City Connecting will build additional terminal facilities in connection with the Union Stock Yards at Kansas City, Mo.

The Klickitat Northern has been incorporated in Washington with a capital stock of \$100,000 to build a line toward Camas Prairie, from Wrights Station on the North Bank Road.

The Louisville & Nashville has awarded contract to Mason, Hanger & Carmichael to build a cut-off about three miles long from its line at Woods, near Lexington, Ky., to the Lexington & Eastern line at Montrose.

A charter has been issued in Georgia to the Washington and Lincolnton, which the promoters propose to construct and operate between the towns named, a distance of about 25 miles. Capital stock is fixed at \$100,000, with the privilege of increasing to \$250,000. Among the incorporators are: W. B. Crawford, W. T. Florence, W. C. Powell, Lincolnton; J. R. Dyson, W. T. Johnson, K. A. Willhoit, Washington.

Work is to be started shortly on the Modoc Northern, a branch of the Southern Pacific, from Westwood Junction through Lookout, Cal., to Midland on the California Northeastern. Contracts for 70 miles of line north from Westwood Junction have been let, the Utah Construction Co., Ogden, Utah, having part of the work, it is said.

The Minneapolis, Mille Lacs & Northern, now operating between Aitkin, Minn., and Anoka, has secured right of way toward Aitkin, the proposed northern terminus, as far as Ogilvia and the company expects to build to St. Francis this season.

The Northern Pacific, it is reported, will build a branch line from Elliott to Harlem, N. D., 17 miles.

The Mojave Northern has applied for incorporation, to construct a railroad from Victorville, Cal., to a point near Oro Grande, a distance of 4.7 miles.

The Chicago & North Western may build into Montana from South Dakota, according to rumors afloat in eastern Montana. They are based on the recent incorporation of the Ismay, Ekalaka & Southern, which has projected an electric line from Ismay, southeast via Ekalaka to Bellefourche, S. D., a distance of 140 miles. Bellefourche is on the North Western line, and the extension would be through a territory badly in need of railroad facilities. Kenneth McLean, of Miles City, is one of the promoters of the projected line.

W. T. Winstead, Centralia, Wash., has started grading east from Chehalis, Wash., on the proposed line of the Puget Sound & Willapa Harbor.

The Parker & Colorado, it is reported, will build a railroad from Parker, Ariz., through the Colorado River Indian Reservation.

Personals

PERSONALS.

Do you know of any recent appointments which should appear below, but which do not? If so, you will realize that your coöperation would have enabled us to make our list of appointments more complete. Coöperate with us next month.

Operation

G. W. LUPTON, formerly trainmaster and recently local agent of the Atchison, Topeka & Santa Fe Ry. at San Francisco, has been promoted to superintendent at San Francisco, Calif., succeeding J. Kinnean.

J. H. JACKSON, who has been connected with the office of the general superintendent of transportation of the Baltimore & Ohio R. R. at Baltimore, has been appointed superintendent of the

Newark division, with headquarters at Newark, O., succeeding C. W. Gorsuch, who has been assigned to other duties. Mr. Jackson came to the B. & O. R. R. from the Frisco Lines in April this year. He was born at Terre Haute, Ind., February 28, 1873, and was engaged in farming until he was twenty-one years old, when, in 1894, he became a station helper at Osceola, Mo., with the Blair Line. In 1896 he was made freight agent for the same company at Kansas City, and in 1898, when the Blair Line was absorbed by the Frisco Lines, he became a clerk in the service of that road, being promoted to freight agent in 1900. In 1901 Mr. Jackson was advanced to assistant superintendent at Kansas City and in 1910 to superintendent at Birmingham, Ala., in which position he remained until he entered the service of the B. & O. R. R.

WM. G. BESLER has been appointed president and general manager of the *Central R. R. of New Jersey*, office at New York, N. Y., succeeding Geo. F. Baer, deceased. Mr. Besler was born March 30, 1864, and entered railway service with the C. B. & Q. R. R. in 1880 as trainmaster's clerk. In 1884 he resigned to take a course in the Massachusetts Institute of Technology, class of 1888, and re-entered the service of the C. B. & Q. R. R. upon leaving college, and from 1888 to 1899 was consecutively yardmaster, chief train dispatcher, trainmaster and division superintendent. He entered the

from 1898 to 1900, was trainmaster and assistant superintendent; from the latter date to 1905, superintendent at Omaha, Neb., and the succeeding three years general superintendent of the same road at St. Paul. Mr. Strickland in 1908 then became assistant general superintendent of the C. & N. W., being made general superintendent in 1910, and assistant general manager at Chicago on April 1, 1912, holding the latter position till appointed general manager as noted above.

W. J. TOWNE, promoted to assistant general manager of the *Chicago & North Western Ry.*, was born at Leavenworth, Kan., November 28, 1867, and was graduated from Rensselaer Polytechnic Institute in 1895. He entered railway service in 1886 with the A., T. & S. F. as a rodman in an engineering party. He was subsequently until 1891 instrumentman and assistant engineer, and the following four years he attended college. From 1896 to 1899 he was assistant engineer New York State Canals, and in February of the latter year he went to the C. & N. W. as assistant engineer construction at Boone, Iowa. He was then successively assistant engineer at Kaukauna, Wis., and Escanaba, Mich., until 1902, when he was made division engineer at Baraboo, Wis. In July, 1904, he returned to Escanaba as division engineer, and in October of that year he was made division engineer at Chicago.



WM. G. BESLER, Pres. & Gen. Mgr.
Central R. R. of New Jersey.



S. G. STRICKLAND, General Manager
Chicago & North Western Ry.



O. G. HOPKINS, Superintendent*
Boca & Loyaltown R. R.

service of the Philadelphia & Reading Ry. as division superintendent of their main line in 1899, and a year later was made general superintendent. In 1902 he was transferred to the C. R. R. of N. J. as general manager, and in 1903 was made vice-president and general manager. He was elected president and general manager May 1, 1914.

W. D. CANTILLON, general manager of the *Chicago & North Western Ry.*, has resigned on account of ill health. S. G. STRICKLAND, formerly assistant general manager, has been promoted to general manager to succeed Mr. Cantillon, office at Chicago. W. J. TOWNE, formerly general superintendent, has been promoted to assistant general manager, succeeding Mr. Strickland, and G. B. VILAS, formerly assistant general superintendent, has been appointed general superintendent, succeeding Mr. Towne, offices at Chicago.

S. G. STRICKLAND, promoted to general manager of the *Chicago & North Western Ry.*, was born August 15, 1859, and was educated at the Collegiate Institute and grammar schools at Port Hope and Peterboro, Ont. He commenced railway work in 1877 with the Canadian Pacific as an operator, and from 1878 to 1880, was operator and clerk for the St. P., M. & M. He was then until 1892 successively telegrapher, clerk, agent and general agent for the C., St. P., M. & O., and the following four years was agent and superintendent of terminals at St. Paul, Minn. He was then made chief clerk to the general superintendent;

From March to July, 1906, he was engineer of permanent improvements, being appointed engineer maintenance of way on the latter date, which position he held until April, 1912, when he was made general superintendent at Chicago, which position he held till appointed assistant general manager as noted above.

H. H. SHEPARD, formerly general superintendent of the Charlotte Harbor & Northern Ry., has been appointed superintendent of the *Delaware, Lackawanna & Western R. R.* at Buffalo, N. Y., succeeding L. J. Ferritor.

E. W. DEUEL, formerly trainmaster, has been promoted to superintendent of the *Denver & Rio Grande R. R.*, Colorado lines, at Gunnison, Col. He succeeds R. C. TEN EYCK, appointed superintendent, Utah lines, at Helper, Utah., succeeding N. A. Williams.

Following a reorganization, E. DOWLING, formerly trainmaster on the A. T. & S. F. Ry., has been appointed superintendent of the Southern district of the *Detroit, Toledo & Ironton R. R.*, office at Springfield. J. H. FRASER, formerly superintendent of the entire line, has been assigned to the Northern district as superintendent, office at Springfield, O.

S. C. STICKNEY, formerly assistant to president, has been appointed assistant general manager of the *Eric R. R.* at New York, N. Y.

W. W. HOUSTON, formerly trainmaster, has been promoted to acting superintendent of the *Hocking Valley Ry.* at Columbus, O., succeeding T. M. Connors.

*Appointment noted in May issue.

H. C. McCLANAHAN has been appointed division superintendent of the *Mexico North-Western Ry.* at Pearson, Mex.

C. H. MOTSETT, formerly superintendent of the N. Y. N. H. & H. R. R., has been appointed general superintendent and chief engineer of the *Panama R. R.*, office at Colon, Panama, succeeding Frederick Mears, appointed to a position on the Alaska Railroad Commission.

H. O. HALSTED, formerly assistant general manager, has been appointed inspector of transportation of the *Pere Marquette R. R.*, office at Detroit, Mich.

ELISHA LEE has been appointed general superintendent of the *Philadelphia, Baltimore & Washington R. R.*, office at Wilmington, N. C. He was born at Chicago, Ill., Sept. 24, 1870. At the age of seven his family moved to Trinidad, B. W. I., where he remained until 1883. He then went north and attended the public schools of Binghamton, N. Y., and "The Gunnery," Washington, Conn. He graduated from the Massachusetts Institute of Technology in the class of 1892. Mr. Lee entered the service of the Pennsylvania R. R. in November, 1892, as rodman in the office of the division engineer of the Tyrone division. From August, 1895, to October, 1897, he was on leave of absence attending to personal affairs. He was appointed assistant supervisor in April, 1899, and served in that capacity on various divisions until April, 1901, when he was

succeeds D. K. Colburn, and his office remains at Houston, Tex.

J. R. PEEBLES has been appointed general manager of the *Tavares & Gulf R. R.*, office at Tavares, Fla., succeeding C. A. Carpenter, resigned.

The headquarters of S. ENNES, general superintendent of the *Western Maryland Ry.*, have been moved from Baltimore to Hagerstown, Md.

The headquarters of F. P. BAIR, superintendent of transportation of the *Wheeling & Lake Erie R. R.* have been moved from Cleveland to Brewster, O. The headquarters of C. W. COE, superintendent, F. E. BARBER, superintendent, and D. J. MORRIS, assistant superintendent, have been moved from Canton to Brewster, O.

Engineering

W. C. EDES chief engineer of the Northwestern Pacific R. R.; LIEUT. FREDERICK MEARS, general superintendent and chief engineer of the Panama R. R., and THOMAS RIGGS, Jr., of the United States coast and geodetic survey, have been appointed members of the *Alaska Railroad Commission*.

The headquarters of A. F. NICHOL, division engineer of the *Atlantic Coast Line R. R.*, have been moved from Gainesville, Fla., to Wilmington, N. C. E. B. HILLEGASS, formerly resident engi-



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W. J. TOWNE, Asst. Gen. Mgr.
Chicago & North Western Ry.

appointed supervisor. In August, 1903, Mr. Lee was promoted to assistant engineer in the maintenance of way department, and advanced to principal assistant engineer on the P. B. & W. R. R. division on April 1, 1907. On March 24, 1909, Mr. Lee was appointed superintendent of the N. Y. P. & N. R. R., and on March 3, 1911, he was made assistant to the general manager of the Pennsylvania R. R., which position he held till his appointment as general superintendent of the P. B. & W. R. R., noted above.

J. C. NOLAN has been appointed superintendent of the *St. Louis, Brownsville & Mexico Ry.* at Kingsville, Tex., succeeding R. F. Carr, transferred.

W. C. HUDSON has been transferred and appointed superintendent of the Washington division of the *Southern Ry.*, office at Alexandria, Va. He succeeds G. V. PEYTON, appointed superintendent of the Columbia division at Columbia, S. C., in place of Mr. Hudson.

L. B. WICKERSHAM, formerly chief electrical engineer, has been promoted to assistant general manager of the *Spokane & Inland Empire R. R.*, the *Oregon Electric Ry.* and the *United Ry.*, office at Portland, Ore.

I. A. COTTINGHAM, assistant general manager of the H. & T. C. R. R. and the H. E. & W. T. Ry., has had his jurisdiction extended over the rest of the *Sunset Central Lines*, including the G. H. & S. A. Ry., the L. W. Ry., M. L. & T. Ry. and the T. & N. O. Ry. He



ELISHA LEE, General Superintendent
Philadelphia, Baltimore & Washington R. R.

neer, has been appointed assistant engineer at Rocky Mount, N. C., succeeding J. B. Adkins.

E. J. CORRELL has been appointed division engineer of the *Baltimore & Ohio South Western R. R.* at Chillicothe, O., succeeding H. M. Hayward.

F. C. SHEPHERD is valuation engineer of the *Boston & Maine R. R.*, and not of the Boston & Albany, as stated in our May issue. F. K. IRWIN is in charge of valuation on the *Boston & Albany R. R.*, with the title of assistant valuation engineer.

The headquarters of C. H. N. McCONNELL, engineer maintenance of way of the *Canadian Northern Quebec Ry.*, have been moved from Quebec to Montreal, Que.

F. L. HEWITT, formerly assistant engineer, has been promoted to office engineer of the *Central of Georgia Ry.*, office at Savannah, Ga.

HERBERT FORSYTHE has been appointed assistant engineer of the *Central R. R. of New Jersey* at New York, N. Y.

J. S. McBRIDE, formerly assistant engineer, has been appointed assistant valuation engineer of the *Chicago & Eastern Illinois R. R.*, office at Chicago, Ill.

G. M. RICE, division engineer of the *Chicago, Milwaukee & St. Paul Ry.*, has been transferred from Spokane, Wash., to Butte, Mont.

IRVING C. BROWER has been appointed assistant engineer of the *Chicago, St. Paul, Minneapolis & Omaha Ry.* at St. Paul, Minn.

R. BUDD, recently chief engineer and previous to that assistant to president of the *Great Northern Ry.*, has been re-appointed assistant to president, office at St. Paul, Minn. A. H. HOGELAND, recently consulting engineer and previous to that chief engineer, has been reappointed chief engineer, office at St. Paul, Minn. O. S. BOWEN, formerly resident engineer, has been promoted to principal assistant engineer, office also at St. Paul, Minn.

As announced in our May issue, J. C. BECKWITH has been appointed engineer of construction of the *Intercolonial Ry.*, and also of the *Prince Edward Island Ry.*, office at Moncton, N. B. He was born at Fredericton, N. B., August 1, 1875, was educated at that place, and in 1898 entered the service of the Columbia & Western Ry. as rodman, and later was appointed draftsman. He entered the service of the Canadian Pacific Ry. in 1900 as draftsman, and went with the Algoma Central & Hudson Bay Ry. in the same capacity in 1901. From 1901 to 1904 he was employed in the construction department of the western lines of the Canadian Pacific Ry., holding successively the positions of draftsman, leveller, transitman and resident engineer. In 1905 he was appointed assistant engineer in the construction department of the eastern lines. He was engineer in charge on the New Brunswick Southern Ry. in 1907-1908, and division engineer of the New Canadian Co.

engineer of the *M. P. Ry.* at St. Louis, Mo. F. NEHER, formerly assistant engineer on construction, has been appointed assistant engineer in the maintenance of way department at St. Louis, Mo. R. H. HALLSTED, assistant engineer, has been transferred from Little Rock, Ark., to Kansas City, Mo. W. R. LUHN, assistant engineer, has been transferred from Wichita to Coffeyville, Kan. P. V. SHERMAN, assistant engineer, has been transferred from Falls City, Neb., to Wichita, Kan. P. T. SIMONS, assistant engineer, has been transferred from St. Louis, Mo., to Little Rock, Ark. E. SULLIVAN, assistant engineer, has been transferred from Kansas City, Mo., to Falls City, Neb. R. E. WARDEN, assistant engineer, has been transferred from Coffeyville to Atchison, Kan.

J. W. WILLIAMS has been appointed assistant chief engineer of the *Northwestern-Pacific R. R.*, office at San Francisco, Calif.

E. V. BRADEN has been appointed engineer of the *Pittsburgh, Chartiers & Youghiopheny Ry.*, office at Pittsburgh, Pa., succeeding Thos. H. Johnson, deceased.

H. E. TYRRELL, formerly office engineer, has been promoted to supervising engineer of the *Southern Ry.*, office at Washington, D. C., succeeding H. N. Rodenbaugh. S. D. NEWTON, formerly assistant engineer, has been promoted to office engineer, office at



A. F. DORLEY, Prin. Asst. Engr.
Missouri Pacific Ry.



J. A. LOHMER, Assistant Engineer
Missouri Pacific Ry.

in 1909. He returned to the C. P. Ry., eastern lines, as assistant engineer in 1909, and was appointed assistant engineer of the Canadian Government Rys. in 1913. He held the latter position till his appointment as engineer of construction, noted above.

M. C. CLEVELAND has been appointed valuation engineer of the *Lehigh Valley R. R.*, office at New York, N. Y. He was educated at Case School of Applied Science, Cleveland, O., and in 1902 entered the service of the B. & O. R. R. as instrumentman on construction. In July, 1903, he was appointed assistant engineer on the Clover Leaf Lines, and in May, 1904, was appointed assistant engineer maintenance of way of the C. C. C. & St. L. Ry. He was appointed division engineer on the Michigan Central R. R. in June, 1907, and in October, 1910, was appointed special engineer for vice-president C. E. Schaff at Chicago. In August, 1911, he was appointed engineer maintenance of way of the Chicago, Indiana & Southern R. R., which position he held till his appointment as valuation engineer.

The headquarters of G. B. HOWARD, chief engineer of the *Middle Tennessee R. R.*, have been moved from Franklin to Nashville, Tenn.

A. F. DORLEY, formerly engineer of water service, has been promoted to principal assistant engineer of the *Missouri Pacific Ry.*, office at St. Louis, Mo. J. A. LAHMER, recently locating engineer of the *Utah Ry.* and previously principal assistant engineer of the *Kansas City Southern Ry.*, has been appointed assistant

Washington, D. C., succeeding J. I. Lee. M. P. NORTHAM, formerly assistant engineer, has been promoted to office engineer at Washington, D. C., succeeding Mr. Tyrrell. H. M. BROWN has been appointed junior engineer at Washington, D. C.

H. F. JONES has been appointed engineer of structures of the *Sunset Central Lines*, office at Houston, Tex.

The headquarters of R. J. MCCOMB, engineer maintenance of way, and S. S. SENTER, engineer of construction of the *Wheeling & Lake Erie R. R.*, have been moved from Canton to Brewster, O. C. V. WYCKOFF, assistant engineer, has been transferred from Cleveland to Harmon, O.

Bridges and Buildings

R. B. PRATT has been appointed architect of the *Canadian Northern Ry.*, office at Winnipeg, Man. K. D. McLAY, bridge and building master, has been transferred from Vermillion to Big Valley, Alta. F. N. PHELPS has been appointed bridge and building master at Edmonton, Alta.

J. B. GAUT, formerly assistant engineer on valuation, has been appointed superintendent of bridges and buildings of the *Grand Trunk Ry.* at Chicago, Ill., succeeding C. O. Busbey.

G. H. FRAZINE, formerly assistant master carpenter, has been appointed master carpenter of the *Lake Shore & Michigan Southern Ry.* at Cleveland, O., succeeding F. A. Beeman.

R. E. JAMES has been appointed supervisor of bridges and buildings of the *Lehigh Valley R. R.* at Hazleton, Pa., succeeding A. E. Kemp.

WALTER WALKER has been appointed foreman of bridges and buildings of the *South Dakota Central Ry.* at Sioux Falls, S. D., succeeding R. T. Walker, deceased.

Signal

F. BORNITZKE has been appointed signal foreman of the *Chicago, Milwaukee & St. Paul Ry.* at Watertown, Wis. P. A. MURRAY has been appointed signal foreman at Milbank, S. D.

SAMUEL MISKELLY has been appointed principal assistant signal engineer of the *Chicago, Rock Island & Pacific Ry.*, office at Chicago, Ill. He was born in the northern part of Ireland, May 12, 1876, and was five years old when his parents came to this country, settling in Illinois. Following the completion of the public school course in the Chicago schools he worked for five years at the carpenter's trade in that city, and in November, 1899, entered the employ of the Union Switch & Signal Co. as a carpenter, building towers. While in the employ of this company he worked as mechanical interlocking fitter, as mechanical interlocking fore-



SAMUEL MISKELLY, Prin. Asst. Sig. Engr.
Chicago, Rock Island & Pacific Ry.

man for a short time, and was also engaged on the installations of electro-pneumatic interlocking and style "B" automatic block signals. In July, 1903, he left the employ of the Union Switch & Signal Co. and became signal maintainer for the C. & W. I. Ry., where he remained until November, 1904. On this date he was appointed signal construction foreman for the C. R. I. & P. Ry., remaining in this position until December, 1906, when he was appointed signal inspector, with headquarters at Cedar Rapids, Iowa, and was later transferred to Des Moines, Iowa, in the same capacity. On June 15, 1909, he was appointed signal supervisor of the Illinois division, with headquarters at Rock Island, Ill., remaining in that position until February 1, 1910, at which time he was appointed general signal inspector, with headquarters in the signal engineer's office in Chicago. Mr. Miskelly remained in this position until May 1, 1914, the date of his appointment as principal assistant signal engineer of the Rock Island Lines. He succeeded H. K. Lowry, who was appointed signal engineer.

L. WYANT has been promoted to assistant signal engineer of the *Chicago, Rock Island & Pacific Ry.*, office at Topeka, Kan. He graduated from Purdue University in June, 1909, and immediately began work as a laborer on the Rock Island Lines, being employed on interlocking and automatic signal construction. He was promoted to wireman and in 1909 was appointed maintainer of automatic blocks on the Iowa division. He was transferred to Chicago in July, 1910, as maintainer on electric inter-

locking, and in April, 1911, was made draftsman in the office of the signal engineer, but after one month was appointed extra gang foreman and maintainer of A. C. automatic blocks on the Chicago Terminal. From May to September, 1912, he was signal foreman and then went with the C., I. & L. Ry. as signal supervisor. In May, 1913, he returned to the Rock Island lines as general signal inspector, and in August was appointed superintendent of signal construction, which position he held until appointed assistant signal engineer.

P. M. GAULT has been appointed signal inspector of the *Illinois Central R. R.* at Chicago, Ill., succeeding C. Fletcher.

T. J. O'MEARA has been appointed signal inspector on construction, *New York Central & Hudson River R. R.*, office at Albany, N. Y.

As announced in our May issue, L. V. PARLE has been appointed assistant signal engineer of the *Southern Pacific Co.*, office at San Francisco, Cal. He entered the service of this company in July, 1899, as towerman, and one year later was appointed relief towerman on the Los Angeles division. In September, 1902, he was appointed foreman on construction of interlocking plants, and in April, 1904, he was made assistant foreman on automatic signal construction. In June, 1905, he was promoted to foreman of auto-



LEROY WYANT, Asst. Sig. Engr.
Chicago, Rock Island & Pacific Ry.

matic signal construction, installing 60 miles of automatic signals. In April, 1906, he was appointed signal supervisor of the Los Angeles division, and in August, 1911, he was appointed signal inspector of the Pacific system, office at San Francisco, Calif. He held the latter position till his appointment as assistant signal engineer, noted above.

A. P. HIX has been appointed signal engineer of the *Terminal R. R. Association of St. Louis*, office at St. Louis, Mo.

Maintenance of Way

Following a separation of the Algoma Eastern Ry. from the Algoma Central & Hudson Bay Ry., A. J. CAMPBELL has been appointed roadmaster of the *Algoma Central & Hudson Bay Ry.* at Sault Ste. Marie, Ont., succeeding O. Evans.

O. AUBIN has been appointed roadmaster of the *Algoma Eastern Ry.*, office at Sudbury, Ont.

JOHN BLEVENS, formerly section foreman, has been promoted to roadmaster of the *Atchison, Topeka & Santa Fe Ry.* at Rincon, N. M., succeeding R. R. Black.

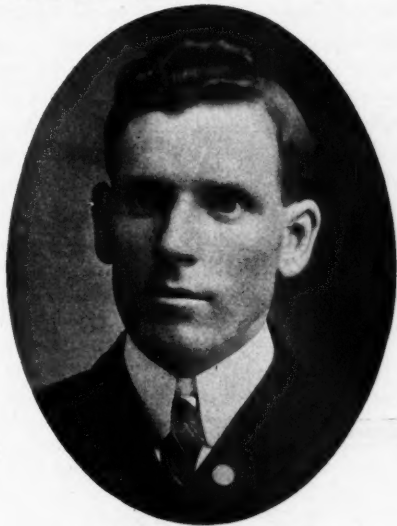
F. S. AUSTIN, supervisor of track of the *Boston & Albany R. R.*, has been transferred from Palmer to Worcester, Mass.

J. MCFADYN has been appointed assistant roadmaster of the *Canadian Northern Ry.*, office at Edmonton, Alta.

B. W. BURTON, formerly at McCormick, has been appointed roadmaster of the *Charleston & Western Carolina Ry.* at Fairfax, S.

C., succeeding J. M. Flanagan. J. D. DEAN has been appointed roadmaster at McCormick, S. C., succeeding Mr. Burton.

T. P. HUNT, roadmaster of the *Denver & Rio Grande R. R.*, Colorado lines, has been transferred from Alamosa, Colo., to Chama, N. M. WM. REYNOLDS has been appointed roadmaster at Alamosa, Colo., succeeding John Ryan.



J. A. RUTLEDGE, Roadmaster
Detroit, Toledo & Ironton R. R.

J. A. RUTLEDGE, formerly acting roadmaster on the C. R. I. & P. Ry., has been appointed roadmaster of the *Detroit, Toledo & Ironton R. R.* at Napoleon, O., succeeding F. O'Brien.

M. MASON has been appointed supervisor of the *Georgia R. R.* at Covington, Ga.

P. MONTGOMERY has been appointed assistant roadmaster of the *Great Northern Ry.* at Minneapolis, Minn. CHAS. TEDHOLM, assistant roadmaster, has been transferred from Judith Gap to Moccasin, Mont. A. V. WAHLGREEN has been appointed assistant roadmaster at Powers Lake, N. D.

J. BRASNAHAN has been appointed supervisor of the *Illinois Central R. R.* at Mattoon, Ill. J. J. DESMOND, supervisor, has been transferred from Grand Junction, Tenn., to Water Valley, Miss. D. E. FOLEY has been appointed supervisor at Carbondale, Ill. He succeeds J. W. KERNS, appointed supervisor at Mounds, Ill., succeeding H. W. Carroll. G. H. PEACOCK, supervisor, has been transferred from Grenada to Water Valley, Miss.

A. J. SMITH has been appointed roadmaster of the *Lake Erie & Western R. R.* at Tipton, Ind., succeeding E. Hogan, deceased.

Effective May 1, the positions of three supervisors of the *Missouri & North Arkansas R. R.* were abolished. J. H. HAWORTH, formerly roadmaster of the entire line, has been appointed roadmaster of the First division, office at Harrison, Ark. THOMAS ESKRIDGE, formerly supervisor, has been promoted to roadmaster of the Second division, office at Searcy, Ark., in place of supervisors Pete Hanson and J. C. Francis, resigned.

J. F. DONOVAN has been appointed supervisor of track of the *Lehigh Valley R. R.* at Delano, Pa., succeeding D. Oaks.

M. KELLER has been appointed supervisor of the *Louisville & Nashville R. R.* at Richmond, Ky., succeeding J. T. Marshall.

J. NEALIS, roadmaster of the *Minneapolis, St. Paul & Sault Ste. Marie Ry.*, has been transferred from Kenmore to Enderlin, S. D. He succeeds J. H. THEDER, transferred to Westerly, Mont.

F. J. MEYER, supervisor of the *New York, Ontario & Western R. R.*, has been transferred from Kingston to Ellenville, N. Y.

S. A. HART, formerly assistant supervisor, has been promoted to supervisor of the *Pennsylvania R. R.* at Johnsonburg, Pa., succeeding W. S. WILSON, transferred to Gallitzen, Pa. E. D. FLAD has been appointed assistant supervisor at Earnest, Pa., succeeding C. S. Hager, promoted.

WM. FOSTER has been appointed roadmaster of the *Skaneateles R. R.* at Skaneateles, N. Y., succeeding Adam Spade.

P. H. LYNCH has been appointed assistant roadmaster of the *Southern Ry.* at Winston-Salem, N. C.

G. J. AYERS, roadmaster of the *Union Pacific R. R.*, has been transferred from The Dalles to Walla Walla, Wash.

F. R. BISHOP, supervisor of the *Yazoo & Mississippi Valley R. R.*, has been transferred from Leland to Rolling Fork, Miss. HENRY MAYNOR has been appointed supervisor at Greenville, Miss., succeeding J. W. Smith.

With The Manufacturers

PERCIVAL CONCRETE TIES.

The Galveston, Harrisburg & San Antonio Ry. has had a test section of Percival concrete ties in service since October 22, 1906. The installation is on the main line at San Leon, Tex., between Galveston and Houston.

The traffic over the line consists of eight fast passenger trains and eight heavy freights each day, with locomotives weighing 100 tons.

The roadbed is in low, wet ground, only a few feet above sea level, and is ballasted with Glidden gravel, a coarse, round gravel.

The concrete ties are 8 ft. long, 8½ in. wide and 8½ in. thick. The centers are V-shaped for 22 in. in the center, and the ties are reinforced with 26 lbs. of corrugated bars. The 33 ft. 80 lb. rails with 5 in. base rest on shock absorbers, consisting of a treated black gum wooden block under each rail, 15½x8x2 in., and weighing 12 lbs. each. The tie complete weighs 460 lbs.

A recent inspection of these ties which have been in use nearly eight years, developed the fact that the ties were over 80% efficient, even when intermingled with wood ties. The latter fail and allow an excessive stress to fall on the concrete ties. At one place the ties were installed consecutively, and no failures have resulted to date. The only maintenance required in the latter was the renewal of six screw spikes which broke, and all of which were located in the two concrete ties adjacent to wood ties.

The screw spikes in these ties screw into sockets which are inserted in the forms when the ties are molded. Spikes may be withdrawn easily, and after eight years the inspection showed the

spikes and sockets in good condition, and all spikes withdrawn were re-applied.

The PERCIVAL CONCRETE TIE & SOCKET CO. controls the patent for the above type of tie.

NEW CATTLE GUARD.

The Century Materials Co., of Chicago, is the manufacturer of an improved cattle guard designed for durability as well as to prevent trespassing of cattle on railroad premises. It is constructed in sections 24 to 34 inches wide and 8 feet long. Each section contains seven longitudinal bars of steel, the ends of which are curved and securely riveted to end cross pieces of the same material. The curved ends make it impossible for any dragging brake-beam or other rigging to become engaged in the guard, and thus prevents serious trouble.

The bars are made V shape, placed sharp edge up. Every other bar is raised above its neighbor, thus preventing the uneven, painful footing that cattle do not like and they keep away from it.

The placing of this guard requires no special ballasting. It is simply set in position and spiked to the ties. Each end cross-piece is punched for spikes, which may be driven into the tie, cutting and not splitting the grain of the wood. It is claimed that it costs less to buy and install this guard than any other on the market, and it has a scrap value when it has outlived its usefulness. It also complies with the recommended practice of the Maintenance of Way Association.

AUTOMATIC TRAIN SPEED CONTROL.

The International Signal Co., New York, has, after much experimentation, developed an apparatus which seems to successfully operate in automatically slowing the speed of trains to a certain predetermined limit for the purpose of insuring safety in operation over track which for some reason may have been rendered permanently or temporarily unsafe at usual speeds. This apparatus is designed for application in connection with the automatic train stop which this concern has had under tests for the past months on the New York, New Haven & Hartford and the Delaware, Lackawanna & Western.

The automatic control is entirely mechanical and its operation is effected through a ball governor and the air brakes. A service application is made with the speed control in the same way as with the automatic stop.

In connection with the tests of automatic stops on the New Haven, it might be mentioned that snow and ice caused some embarrassment but changes in minor details of the International stop seemed, up to the close of winter, to have solved such difficulties.

is pushed forward by the motor spring until it assumes the original position, as shown in Fig. 1. Should the threader come in contact with any immovable object it can be collapsed, as shown in Fig. 3, and withdrawn. This is accomplished by an extra heavy pull on the cord, which compresses the safety spring directly in the rear of the front head. This releases the dogs. They can then be replaced to normal position and are ready for use.

Practical tests of this device proved to the writer that the use of the device will effect a saving to anyone who has any amount of underground conduit to install. It makes no difference what the length of the conduit may be, as the device will go through regardless of the length.

The Specialty Device Co. maintains an office at the Railway Supply Exhibit, 900 Lytton Building, Chicago, where one of these devices is now on display, and where there is also sufficient amount of conduit on hand and demonstrations of the machine are made at any time for interested persons.



Figure 1.

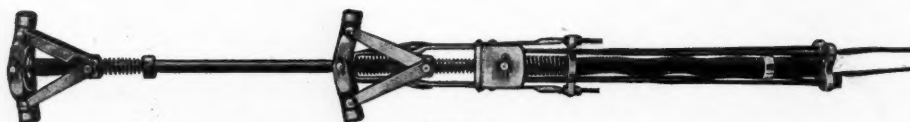


Figure 2.

Figure 3.
Bierce Conduit Threader.

THE BIERCE CONDUIT THREADER.

The Specialty Device Company, of Cincinnati, has recently placed on the market a device known as the Bierce Conduit Threader, which has been devised to displace the present system of rodding wire through conduits. This machine is the first and only device that has even been manufactured for this purpose that really does the work intended for it to do.

It displaces rods completely for threading conduits, and it accomplishes the purpose with great speed and economy. This device travels at the rate of a foot per second, regardless of the condition of the conduit, and it is so made that it will overcome all troubles that one is likely to experience while rodding. In other words, it works under any and all conditions. In a recent test, conducted in the city of Chicago, this machine traveled through 332 feet of conduit in approximately 345 seconds, and the entire operation was performed by only one man. In other words, the duct was threaded in less than six minutes, which is really a shorter time than it is possible for the average construction crew to unload and untie their rods.

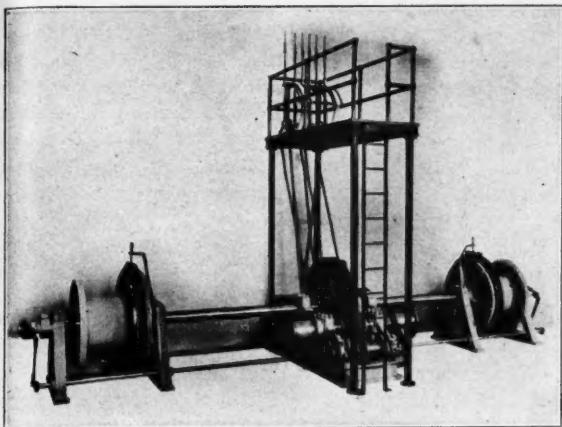
This machine is only 46 inches long and weighs less than ten pounds. It is adjustable for any conduit ranging from 3¼ inches to 4 inches. The shape of the conduit makes no difference whatever; the machine is equally as efficient in round as in square conduits. In order to operate this machine, it is only necessary to attach a cord to the ring, as shown in the illustration herewith. The illustration also shows the threader in its normal position. When the cord is pulled the front head is pushed forward, as shown in Fig. 2 (a distance of 15 inches) and the motor spring behind the rear head is compressed. Upon releasing the cord, the front head remains stationary, and the rear head

SPECIAL DOUBLE DRUM CAR FLOAT ENGINE.

The engine illustrated herewith was designed and built for the Puget Sound & Willapa Harbor Ry. for installation on a car float having a capacity of six freight cars, being 158 feet long. The hoist is designed for a duty of 16,400 lbs. at 80 ft. per minute, and is to be used for pulling freight cars from the float onto the float bridge by an endless rope system, the rope winding off one drum, passing over several track sheaves, and winding on the other drum. The grades between the float and land tracks vary from 1 to 5 per cent, according to the tides. The cars handled weigh 70 tons each, and they will be pulled off in trips of three when the grade is but 1 per cent, and singly when the grade is as steep as 5 per cent.

The engine will be located at one end of the float and the other end will always be moored to the bridge when a landing is made. The drums are so arranged as to be placed on the outer sides of the two sets of tracks on the float. The operation of discharging cars will consist of mooring the craft so that one of its tracks will coincide with the float bridge track, the rope led around the several sheaves and the engine started in such a direction as to pull the cars on that float track onto the bridge; then the float is moved so that its other track coincides with that of the bridge, the engine is reversed and will then run in such a direction that the cars on this latter float track will be pulled onto the bridge.

The engine is of a special design having double 9 x 10 cylinders, steel gears, a double acting brake on each drum, and is equipped with reversible link motion. The frictions are of the cork insert type, one for each drum, and are separately operated. Each drum is capable of coiling 1,800 ft. of ¾-inch



Double Drum Car Float Engine.

rope, thus giving the engine the ability of not only discharging the cars but of pulling them quite a distance across the float bridge. The whole machine is of rugged construction, and is easily operated by hand levers assembled on an operating platform, which is of such a height as to allow the man a clear view over the cars which are being handled. The whole installation is so arranged as to minimize the amount of total space required, and to afford a very efficient means of performing the required duty.

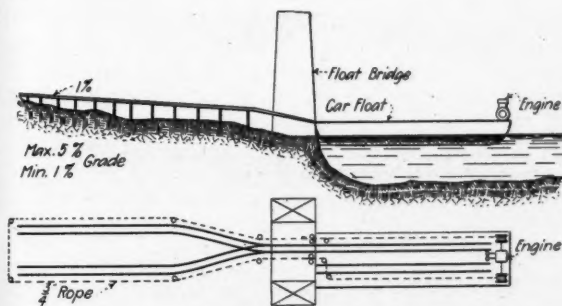


Diagram of Car Float.

The engine was designed and constructed by the Lidgerwood Mfg. Co., New York.

FASTENER FOR TANK DRAW BANDS.

The E. C. Tecktonius Manufacturing Company, Racine, Wis., manufacturer of the "Tecktonius" draw band fastener, was the introducer of the "rivetless" fastener for round and flat bands on tanks, and other round wooden receptacles. This appliance was introduced about 25 years ago and was a radical departure from the old-time methods of fastening bands together with rivets. It operates on the "clamp and wedge" principle, which insures that the greater the strain the stronger the fastener grips. It is made of the very best malleable iron, and each fastener, before leaving the factory, is subjected to the hammer-test, which insures its being free from flaw and defect.

The remarkable gripping power, strength and durability of this fastener makes the band connection stronger than the band itself. It also avoids rivets, which are in time liable to rust, shear or pull off, thereby jeopardizing the safety of the tank and its contents. Rivet holes as well are a source of weakness to the band.

The merit of this band fastener is not limited to its greater strength, durability and dependability, but covers as well the greater ease with which it can be applied, adjusted and re-



Tecktonius Round Iron Fastener.



Tecktonius Single Bolt Band Fastener.

moved, without skilled labor. This work can be done very easily and quickly by an ordinary workman.

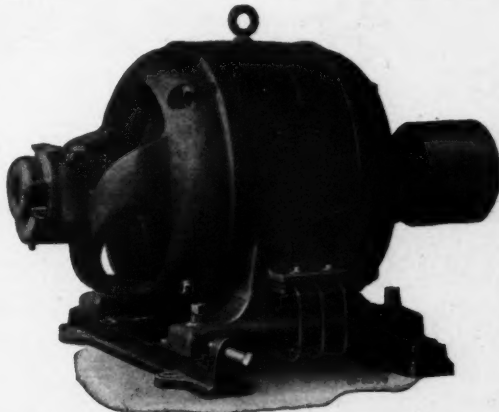
STARTERLESS, POLYPHASE MOTOR.

The Wagner Electric Manufacturing Co. has recently developed and placed on the market a polyphase motor which requires merely the closing of the service switch for starting.

This motor is so designed that at starting it exerts about two and three-quarter times full load torque. When the motor has attained full speed the centrifugal mechanism changes the connections of the armature and it then runs with characteristics similar to the ordinary squirrel cage type motor. In other words, instead of an external starter, the starter is an integral part of the motor itself.

This arrangement makes it possible for the most unskilled workman to be able to start the motor without danger to himself or damage to the motor.

This motor is particularly adaptable to pump service, and



Starterless, Polyphase Motor.

especially so when the motor is controlled by an automatic float switch. It is, therefore, very desirable for railroad water supply tanks, and many of them have been used for this purpose. It is also very desirable for remote control service, as only three wires have to be run from the supply circuit to the motor, the switch being located at any convenient point in the motor circuit. For general machine shop drive this motor is unexcelled. The illustration shows a 25 H.P. motor of this type.

The McKeen Motor Car Co., Omaha, Neb., has recently delivered a 55-foot freight and express motor car to the Minneapolis & Northern, and a 70-foot motor car to the Minneapolis, St. Paul & Sault Ste. Marie. A 70-foot McKeen car has been ordered by the Central New York Southern and one of similar design has been ordered by the Arkansas Northwestern.

New Literature

Copies of catalogues or bulletins mentioned herein may be obtained by addressing RAILWAY ENGINEERING.

SCARRITT COMSTOCK FURNITURE CORPORATION, being a reorganization of the Scarritt Comstock Furniture Company, retaining practically the same personnel, capitalization and facilities, is preparing a publication for distribution that will contain valuable data for use in furnishing passenger car interiors—not only coach seats, but parlor chairs, dining chairs, reclining chairs and specialties generally in furniture for car interior furnishings. Depot and station settees, station agents' desks, and a complete line of railroad furniture will be covered in the publication.

THOMAS A. EDISON, INC., has issued a booklet descriptive of the Edison primary cell as applied to the track circuit. The first section discusses the track circuit, its requirements, and the function of the battery. Following this the requirements of an ideal cell are discussed. The descriptive matter concerning the Edison B S C O battery cell, with external resistance for use in track circuit work, is discussed very fully covering flexibility, effective capacity, visible indication of approaching exhaustion, constancy of voltage, saving in cost, housing, and interchangeability with signal batteries. An approximate rule is given for the amount of external resistance required, and a method is outlined for checking up this resistance so that it may be modified if necessary. This booklet contains data of interest to every man concerned with the maintenance and operation of track circuits.

* * *

THE GENERAL RAILWAY SIGNAL CO. has issued a number of loose leaves for inserting in the standard loose leaf cover issued a year or so ago. Illustrations, data, and list prices are given for the various parts of the R. S. A. standard mechanical dwarf signal, pipe connected with upper quadrant indication. Similar data is given for wire connected, upper quadrant indication mechanical dwarf signal. These sheets will be found useful both for estimating new work and ordering renewal or repair parts.

Industrial Notes

Mr. Ed. H. Barnes, southern representative for S. F. BOWSER & CO., INC., has severed his connections with that company, effective May 15th. Mr. Barnes is an exceptionally bright man, but for personal reasons he finds it expedient to make a change.

J. W. Dodge, Jr., formerly connected with the P. & M. Co., has accepted a position with the TRACK MAINTAINER CO., of Memphis, Tenn. He has charge of the Chicago office, with headquarters in the Lytton building, Chicago.

At the annual meeting of the stockholders of the JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J., on April 20, the retiring board of directors and Geo. T. Smith, president; George E. Long, vice-president; J. H. Schermerhorn, treasurer; Harry Dailey, secretary, and Albert Norris, assistant treasurer and assistant secretary, were re-elected.

PAUL DICKINSON, INC., has moved the Chicago office from the Security building to 3346 South Artesian avenue, and has discontinued the downtown office.

FLINT & CHESTER, INC., New York, have been appointed eastern selling agent for the National Graphite Lubricator Co., Scranton, Pa.

THE KEYSTONE CONSTRUCTION CO., Erie, Pa., will ask a charter of the state of Pennsylvania. The company will manufacture

equipment and construct railways, terminals, bridges and buildings.

THE MORDEN FROG & CROSSING WORKS has moved its Chicago office to 1873 Continental and Commercial Bank building, 208 South La Salle street.

L. R. POMEROY, consulting engineer, has removed his New York office to 16 West Sixty-first street.

THE T. L. SMITH COMPANY, of Milwaukee, Wis., has taken over the Chicago Mixer, formerly sold by the Chicago Concrete Machinery Company, Chicago, Ill.

THE PAXTON & MITCHELL COMPANY, of Omaha, have taken space for exhibit and sales offices in the Railway Supply Permanent Exhibit, 900 Lytton Bldg., Chicago.

Richard F. Spamer has been appointed general manager of the STENTOR ELECTRIC MANUFACTURING COMPANY, INC., New York, a recently-formed company which is now taking over the business of the Electrical Experiment Company of the same city. Mr. Spamer was born in St. Louis on March 29, 1878.

THE PHILLIPS MANUFACTURING CO., of New York, manufacturers of commutator grinders, have opened a western sales office in the Railway Supply Permanent Exhibit, 9th floor, Lytton Bldg., Chicago.

THE STEPHENS COMPANY, railway advertising specialists, have established a branch office of the Railway Supply Permanent Exhibit, 900 Lytton Bldg., Chicago, which will be run in conjunction with the main office in the Great Northern Bldg.

William H. Donner, president of the CAMBRIA STEEL CO., has been elected also chairman of the board of the PENNSYLVANIA STEEL CO.

C. P. Williams, formerly with the National Lock Washer Co., has become associated with THE EFFICIENCY COMPANY, Railway Exchange, Chicago.

J. Howard Ewald, president of the PITTSBURGH FORGE & IRON CO., died on May 18.

T. B. Bowman, for the past five years assistant to the president and eastern sales manager of the Q & C COMPANY, New York, has severed his connection to become president of THE EFFICIENCY COMPANY, with office in the Railway Exchange, Chicago.

THE CARTER WHITE LEAD WORKS, of West Pullman, Ill., has placed a contract for a factory building, calling for 1,425 tons of structural steel.

THE CHICAGO CONCRETE POLE CO., operating under the Lienish & Aschaur patents on cruciform section poles, has taken offices in the Railway Supply Permanent Exhibit, ninth floor Lytton building.

THE ELECTRIC WATER STERILIZER CO., of Scottdale, Pa., is installing an interesting exhibit of its apparatus for treatment of water by electric process in the Railway Supply Permanent Exhibit. This will also be their Chicago sales office.

THE KENNEDY-VANDERHOOF CO., has moved its office and display room to the Railway Supply Permanent Exhibit, 900 Lytton building, Chicago, where an attractive line of metal suit cases, tool cases, etc., will be on display.

THE CHICAGO STEEL TAPE COMPANY has established a downtown office at 900 Lytton building, Chicago.

MORGAN T. JONES & Co., of Chicago, have incorporated under the name of Morgan T. Jones Company.

THE PRINCE GROFF COMPANY has elected new officers and moved its general offices to 50 Church street, New York. The new officers are Sherman W. Prince, president; George W. Steinmetz, treasurer, and Clarence B. Groff, vice-president. Charles H. Spotts has been appointed sales manager.

Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until June 13 for one 20-ton locomotive crane delivered and erected at the navy yard, Boston, Mass. Specifications and other particulars can be obtained on application to the bureau or to the commandant of the navy yard named.

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